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Mr. Jim F. Snyder
Remediation Program Manager
HQ AFCEE/MMR
322 East Inner Road, Box 41
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SUBJECT: Contract F41624-97-D-8006
MMR Plume Response Program
DO 18 DCN/PROJECT # AFC-J23-35S19002-M17-0014
***Final FS-28 Non-Time-Critical Removal Action Memorandum***

Dear Mr. Snyder:

As directed by the Air Force Center for Environmental Excellence, Jacobs Engineering Group Inc. is hereby providing 22 bound copies, one unbound copy, and one electronic copy of the above referenced document, dated November 1999. Copies are also being sent to the appropriate agencies.

Please feel free to contact me or Lauren Foster at (508) 564-5746 extension 316, if you have any questions or comments.

Sincerely,

Eric W. Banks, P. E.
Program Manager

EWB/cle

Enclosures: Document (23 & 1 EDD)

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AFCEE | Air Force Center for Environmental Excellence |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| cfs | cubic feet per second |
| CS-4 | Chemical Spill-4 |
| CWSW | Coonamessett Water Supply Well |
| DEP | Massachusetts Department of Environmental Protection |
| DERP | Defense Environmental Restoration Program |
| DPH | Massachusetts Department of Public Health |
| EDB | ethylene dibromide |
| EE/CA | Engineering Evaluation and Cost Analysis |
| EPA | U.S. Environmental Protection Agency |
| ETR | extraction, treatment and reinjection system |
| FFA | Federal Facility Agreement |
| FS-28 | Fuel Spill-28 |
| ft/day | feet per day |
| GAC | granular-activated carbon |
| gpm | gallons per minute |
| HWMR | Hazardous Waste Management Regulations |
| IRP | Installation Restoration Program |
| MCL | maximum contaminant level |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| MGL | Massachusetts General Law |
| MMR | Massachusetts Military Reservation |

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NOI | Notice of Intent |
| NPL | National Priorities List (Superfund) |
| PRP | potentially responsible party |
| RCRA | Resource Conservation and Recovery Act |
| REC | risk equivalent concentration |
| RI/FS | Remedial Investigation/ Feasibility Study |
| ROD | Record of Decision |
| SVOC | semi-volatile organic compound |
| SWOU | Southwest Operable Unit |
| TCE | trichloroethene |
| USGS | U.S. Geological Survey |
| VOCs | volatile organic compounds |
| µg/L | micrograms per liter |

## EXECUTIVE SUMMARY

This document presents actions to be undertaken in response to the FS-28 plume. Previous time-critical actions taken in response to this plume actively treated the areas of highest contaminant concentration. Additional actions are being implemented as a non-time-critical removal action to protect human health by reducing exposure to ethylene dibromide occurring in the surface water, groundwater, and cranberry bogs, while minimizing impacts to the ecosystem, and accelerating the restoration of the Coonamessett River.

Proposed actions to mitigate or manage risk from the discharge of ethylene dibromide to surface waters include extraction of groundwater through shallow well-points and treatment of this water with the existing FS-28 treatment system. Treated water will be discharged to the river through an existing bubbler or to cranberry bogs that abut the river through bubblers to be constructed. In addition, several active bogs will be separated from the Coonamessett River using newly constructed berms or sheet piles.

# 1.0 PURPOSE

The purpose of this *FS-28 Non-Time-Critical Removal Action Memorandum* is to request and document approval of supplemental response actions that are planned for the Fuel Spill-28 (FS-28) ethylene dibromide (EDB) plume located south of the Massachusetts Military Reservation (MMR), a National Priorities List (NPL) site in Barnstable County, Massachusetts. Response actions are being managed by the Air Force Center for Environmental Excellence (AFCEE) under the direction of the U.S. Environmental Protection Agency (EPA), as specified in Amendment No. 1 (EPA et al. 1996) to the Federal Facility Agreement (FFA) (EPA et al. 1991). The Massachusetts Department of Environmental Protection (DEP) is not a signatory to the FFA, but is an active participant in the clean-up process and provides guidance and direction to the process through several chartered boards and committees. The proposed response actions are being implemented by the Air Force as a non-time-critical removal action to prevent the exposure of the public and cranberry workers to EDB, and to accelerate the restoration of the Coonamessett River.

The FS-28 plume was not included in the *Record of Decision for Interim Action* (Stone & Webster 1995) which addressed six of the plumes emanating from the MMR. However, it was included in the amendment to the FFA of April 24, 1997. In May 1996, AFCEE assumed management of the Installation Restoration Program (IRP) at MMR to manage the environmental investigation and remediation activities. The draft *Strategic Plan* (AFCEE 1996) committed to (1) conducting a field investigation to delineate the leading edge of the FS-28 plume; (2) preparing a technical memorandum to present the findings of the investigation; and (3) making recommendations for action, if necessary, and (4) conducting a complete remedial investigation and feasibility study (RI/FS) to address the entire plume. The *Draft FS-28 Technical Decision Memorandum* (AFCEE 1997a) presented the data collected during the EDB RI/FS Data-Gap Sampling Field Program, and recommended the following response actions:

- implement surface water and groundwater decision rules by which periodic monitoring data would be used to manage risk;
- connect selected residences to the public water supply;
- evaluate interim response alternatives for remediation options in the southern area of the FS-28 plume.

The construction of an extraction, treatment and discharge system was divided into a time-critical removal action, a non-time-critical removal action, and a final remedy. Previously, an action memorandum, which described time-critical response actions for the hot spot of the FS-28 plume, was prepared (AFCEE 1997b, 1999a) and approved by AFCEE and EPA.

This non-time-critical removal action memorandum, which is a supplement to the original action memorandum, addresses the selected non-time critical removal actions at the site[1]. An engineering evaluation and cost analysis (EE/CA) was prepared by AFCEE for five alternatives for non-time-critical removal action that could be implemented at the leading edge of the FS-28 plume (AFCEE 1998c). The objectives, as outlined in the EE/CA, are to protect human health by reducing exposure to EDB occurring in the surface water, groundwater, and cranberry bogs while minimizing impacts to the ecological system, and to accelerate the restoration of the Coonamessett River. The EE/CA alternatives ranged from limited actions to further active treatment with realignment of a portion of the Coonamessett River. The recommended alternative includes (1) extraction of shallow groundwater to reduce levels of contamination upwelling into the river and bogs; (2) treatment of extracted water through carbon filtration; (3) discharge of the treated water to surface water; (4) separation of bogs from the river; and (5) provision of clean water for flooding the upper bogs. The final remedy for the FS-28 plume will be selected in conjunction with

[1] The draft FS-28 Non-Time-Critical Action Memorandum was issued in January 1999. Construction activities for the actions described in this document were conducted from February to July 1999. For consistency with the draft document, this Action Memorandum presents the interim actions in future tense as planned work.

the Record of Decision (ROD) for the FS-28 and FS-29 plumes in the Southwest Operable Unit. Furthermore, this non-time-critical removal action will be consistent with the long-term remedial action to be selected in the ROD.

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# 2.0 SITE CONDITIONS AND BACKGROUND

The MMR has been used extensively by several military organizations dating back to the 1930s when the base was first built (Figure 2-1). Most of the industrialized activities associated with the military occurred in the southern portions of the base. Runways, aircraft, vehicle fueling and maintenance, landfills and firefighter training were in operation to support the military.

The heaviest military activity was from 1940 to 1946 by the U.S. Army, and from 1955 to 1972 by the U.S. Air Force. The use of petroleum fuel products and industrial solvents, as well as the generation of hazardous waste material were at a height during these periods. It was common practice for many years to dispose of such wastes in landfills and dry wells, and to use them at firefighter training areas. Contaminants such as fuels and solvents were released to the unsaturated sands (approximately 30 to 60 feet thick). When these products reached the top of the water table, they created groundwater plumes of dissolved organic compounds.

MMR resides on top of the recharge area for the sole-source groundwater aquifer from which all the four surrounding towns draw municipal drinking water. With an average groundwater flow rate of 1 to 2 feet per day, some of the plumes of contaminated groundwater emanating from the MMR extend to distances of more than four miles.

In 1992, EDB was discovered in groundwater in the vicinity of the leading edge of the Chemical Spill-4 (CS-4) plume. Subsequently, there have been several investigations to delineate the extent of EDB south of the CS-4 extraction fence. The plume was officially given a designation as FS-28 in November 1996.

## 2.1 SITE DESCRIPTION

The following paragraphs present a description of site features. Additional site description information can be found in earlier reports (AFCEE 1997a, 1998c, 1999b, 1998d).

### 2.1.1 Removal Site Evaluation

The FS-28 plume, which is currently assumed to be related to past activities at MMR, has migrated south approximately four miles to where it discharges by upwelling into the Coonamessett River. Potential impacts of the plume are discussed in Sections 3.0 and 4.0.

The findings of the field investigation, presented in the *Draft FS-28 Technical Decision Memorandum* (AFCEE 1997a), determined that the leading edge of the FS-28 plume is discharging into the surface waters of the Coonamessett River and associated wetlands, including cranberry bogs, south of Hatchville Road in Falmouth. A portion of the leading edge of the plume, approximately 3 percent of the entire EDB plume mass, continues to migrate in the subsurface. Groundwater modeling completed for the *FS-28 Extraction Well-1 (EW-1) Evaluation Report* (AFCEE 1998a) showed that this portion of the leading edge would not impact surface water and would disperse into the aquifer. As of August 1998, downgradient groundwater monitoring wells have not detected EDB. The groundwater flow, and therefore the migration of EDB, is strongly controlled by the Coonamessett River, which increases significantly in size along the stretch where EDB is upwelling. Numerical groundwater modeling indicates that, if left uncaptured, the EDB plume will continue to discharge to the Coonamessett River for several years and that the plume is effectively captured within the river valley.

The proposed response actions will mitigate the potential risk to human health and the environment at the leading edge of the FS-28 plume.

### 2.1.2 Physical Location

The MMR is located on Upper Cape Cod, and lies within the towns of Bourne, Falmouth, Mashpee, and Sandwich. The upgradient extent of the FS-28 plume, as currently mapped, is located in the Crane Wildlife Management Area, which is south of MMR in Falmouth. The plume has a north-south orientation, is bounded on the east by Coonamessett Pond, on the west by Deep Pond, and extends to a point south of

Hatchville Road in Falmouth. The leading edge of the plume is narrow, and is located upgradient of Thomas Landers Road. The plume axis at the toe generally parallels and is coincident with the Coonamessett River, which flows south from the western arm of Coonamessett Pond to a tidal estuary, Great Pond, south of Route 28 in Falmouth.

The location for the actions discussed in this memorandum extends from the existing treatment plant located adjacent to the Baptiste Bogs to the Lower Bog (Figure 2-2).

### 2.1.3 Site Characteristics

The physical characterization of the FS-28 plume site has been interpreted from data collected from more than 30 borings drilled in the study area (AFCEE 1997a). The locations for monitoring wells installed in the southern portion or distal section of the FS-28 plume are shown in Figure 2-3.

Measurements by AFCEE and the U.S. Geological Survey (USGS) indicate that the Coonamessett River does not gain water along the reach from its origination point at Coonamessett Pond to the point just up from the confluence with Broad River. Where the river leaves Coonamessett Pond, streamflow measurements have varied between 1.11 and 3.87 cubic feet per second (cfs) (AFCEE 1997b, 1999a). The streamflow data also indicate that there is significant discharge from the aquifer to the river (increase in river flow) between Broad River and Thomas Landers Road. This discharge of water creates a strong upward gradient near the river, as evidenced in nearby well clusters such as 69MW1285.

The FS-28 plume is migrating to the surface south of Hatchville Road (AFCEE 1997a), moving through advective transport with the groundwater, which is flowing south and rising slightly to discharge in the Coonamessett River. The average linear velocities of groundwater flow range from 0.02 to 0.2 feet per day (ft/day) for silty sands, and range from 0.2 to 2 ft/day for outwash (AFCEE 1997a). Various numerical groundwater

models that simulate the FS-28 plume transport have predicted that the discharge location for the EDB is the Coonamessett River.

The cultivated bogs are typically flooded during the winter, beginning in late November to early March to prevent frost damage to the cranberry vines. During flooding, the Coonamessett River is dammed; this raises the water level from 0.5 to 3 feet over the area of the cultivated bogs. Upward vertical gradients are reduced under flooded conditions, which reduce the groundwater and contamination from moving into the bogs.

Approximately 68 acres of agricultural crops south of Hatchville Road are irrigated from either groundwater wells or surface water. Table 2-1 presents a summary of the agricultural water usage for the affected bogs shown in Figure 2-2.

In the spring and summer of 1997, AFCEE installed irrigation wells to provide clean groundwater to all of the surface water users except for the Augusta bog, which is already separated and has its own return reservoir. However, the growers still needed river water for harvesting and winter protection of their cranberry crop.

Studies to date indicate that the EDB plume upwells in the upper part of the lower Baptiste bog (Figure 2-4) and flows into the Coonamessett River (AFCEE 1997a). Figure 2-5 presents a cross-section of the FS-28 plume upwelling into the bogs south of Hatchville Road. This upwelling results in detectable concentrations of EDB in the Coonamessett River as it flows through the lower bogs.

### 2.1.4 Release or Potential Release of Contaminants into the Environment

EDB is the primary contaminant of concern in the FS-28 plume; it is also the most prevalent organic compound detected in samples collected in the FS-28 sampling program. The maximum concentration of EDB was detected above the maximum contaminant level (MCL) of 0.02 micrograms per liter (µg/L) at 18 µg/L in deep groundwater samples just south of Hatchville Road. The concentrations of EDB in the

shallow groundwater and surface water are not as high as those in the deep groundwater. In addition, the concentrations in the shallow groundwater are higher than the concentrations in the surface water where EDB is discharging to the surface. The concentrations of EDB in the Coonamessett River decrease downstream. The highest concentration of EDB detected in the surface water and shallow groundwater is 0.36 µ/L and 3.9 µg/L, respectively. Shallow groundwater samples were taken just below the top of the groundwater table at a depth of approximately three to four feet.

Toluene was detected below the MCL of 1000 µg/L at the leading edge of the plume in one groundwater sample at 35 µg/L, and 1,1-dichloroethene was detected below the MCL of 7 µg/L at 2.3 µg/L in another sample. These were the only compounds other than EDB that were detected in the groundwater samples. The monitoring well data indicate that low levels of other volatile organic compounds (VOCs) may be present in monitoring wells southeast of Coonamessett Pond (AFCEE 1997a). Toluene was detected in 12 wells at concentrations ranging from 0.081 to 15 µg/L. Trichloroethene (TCE) was detected below the MCL of 5 µg/L in five wells at concentrations ranging from 0.2 to 1.1 µg/L. These VOCs may be associated with the FS-28 plume; however, a strong correlation has not been established.

Chloroform was detected below the MCL of 100 µg/L in five wells at levels ranging from 0.3 to 1.4 µg/L. Low concentrations of chloroform have also been detected in many of the private wells in the area. The chloroform is not believed to be associated with the FS-28 plume, but exists at low levels in the groundwater on the Upper Cape. Background manganese concentrations also appear to be slightly higher in the area, but manganese is not considered a contaminant of concern. Low concentrations of bis 2-ethylhexyl-phthalate and di-N-butyl phthalate were detected in three wells; however, these semi-volatile organic compounds (SVOCs) are not considered to be contaminants of concern.

Lead was detected in six monitoring wells in the area of the leading edge of the FS-28 plume above the "at tap" drinking water action level of 15 µg/L (AFCEE 1999b). The highest concentration of lead detected was 39.2 µg/L. Background lead concentrations in groundwater of 37.9 µg/L also exceed the drinking water action level. Lead was also detected in bog area surface water and background surface water above the ambient water quality criteria (AFCEE 1999b).

Because EDB is found in the surface waters of the two rivers and bogs, there is a potential for release to the air and exposure to the nearby residents on Little John Road and Thomas B. Landers Road. Modeling has been conducted by the Massachusetts Department of Public Health (DPH) which shows that there is the possibility of adverse effects from long-term opportunities for exposure to EDB in ambient air at some locations downwind of the bogs and reservoirs under some conditions. In 1997, six rounds of air sampling were conducted at three locations where EDB concentrations were measured. The data evaluation concluded that EDB concentrations in air are barely detectable and pose negligible risk (AFCEE 1997b, 1999a).

### 2.1.5 National Priorities List Status

The MMR was added to the National Priority List (NPL) in 1989, designating that the contamination at the base was a serious threat to the public and environment, and required EPA oversight.

## 2.2 OTHER ACTIONS

Several actions have already been taken to mitigate the risk of exposure to EDB in the FS-28 plume. The actions discussed below have already been taken or are ongoing. Ongoing actions which are planned to continue with or without modification will also be discussed in Section 5.0.

### 2.2.1 Previous Actions

Actions that have been completed to date for the FS-28 plume include the following:

- Installed 30 monitoring wells in the vicinity of the river coupled with sampling and analysis to better define the distribution of EDB in these areas.
- Installed a wellhead treatment system to protect Falmouth's water supply well from FS-28 contamination with monthly monitoring of sentinel wells and the raw water supply.
- Conducted a private well sampling and analysis program for residents in the area of the EDB plume.
- Provided bottled water and information about the EDB contamination to 35 residents in the Hatchville area prior to connecting the homes of these residents to the public water supply.
- Installed water mains to connect private residences to the Falmouth public water supply.
- Collected air samples for EDB analysis in the area surrounding Broad River, where the highest surface water concentrations have been found since the testing program was initiated. Air sampling was also conducted during an irrigation (spray) event at the Reservoir bog in July, 1997.
- Installed an eight-inch diameter extraction well (69EW0001) approximately 55 feet south of 69MW1284, within the area of highest EDB concentration, as part of the time-critical removal action. As of August 1999, over 600 million gallons of water have been treated and discharged into the Coonamessett River since the FS-28 treatment system was put into operation in October 1997. Over 4.6 pounds of EDB have been removed from the aquifer by the treatment system.
- Collected surface water samples at 61 locations, extending from the Coonamessett River headwaters at Coonamessett Pond to the outlet to Great Pond.
- Conducted two water level surveys in the FS-28 study area. Forty monitoring wells and piezometers were measured for water depth in a water level survey conducted October 1, 1996. On December 27, 1996, another water level survey was conducted. Water levels were measured in 171 monitoring wells and piezometers and the river stage was measured at nine locations along the Coonamessett River.
- Completed shellfish residue study in August, 1997. The study was planned and coordinated by several Massachusetts state agencies. Shellfish were collected from Green Pond and an appropriate reference area and analyzed for EDB by the Massachusetts Department of Public Health laboratory. No EDB was detected.

- Completed a pilot study of a shallow well-point extraction system to evaluate the effectiveness of an active extraction system to capture groundwater that currently upwells into the Coonamessett River.
- Completed numerical groundwater modeling to evaluate the effectiveness of active extraction systems to capture upwelling of EDB-contaminated groundwater (AFCEE 1998c).
- Completed a remedial investigation in 1998 for the Southwest Operable Unit (SWOU), which included the FS-28 plume.
- Completed a feasibility study for the SWOU in 1999, which included the FS-28 plume.

### 2.2.2 Ongoing Actions

The following actions are ongoing at the FS-28 plume:

- AFCEE is currently operating and maintaining the water supply treatment system at the CWSW. The activities include monthly sampling of the influent well water and upgradient monitoring wells to analyze for the presence of EDB. A preliminary design is being completed for the treatment system that will be turned over to the Town of Falmouth for final design and construction. The wellhead treatment will continue as long as the well continues to be utilized by the town.
- A multi-agency task force developed the cranberry sampling and analysis protocol prior to the 1998 cranberry harvest. An analytical laboratory, selected by AFCEE, (Southwest Research Institute of San Antonio, Texas) tested the cranberries in accordance with the established protocol. No EDB was detected in the samples collected and analyzed in accordance with protocol. It is anticipated that this protocol will be used for the 1999 crop.
- The existing granular-activated carbon (GAC) treatment system for EW-1 continues to operate and extract groundwater at a rate of 600 gallons per minute (gpm).
- Stream discharge measurements or estimates of flow are being made monthly at four cross-sections on the Coonamessett River. The stream flow measurement locations coincide with the surface water sampling sites.
- In and around the area of remediation, EDB analysis is conducted on surface water samples collected monthly from (1) approximately 27 locations in the Coonamessett River system; (2) groundwater samples collected quarterly from approximately 19 wells; (3) irrigation water samples collected annually from approximately 13 sources, and (4) irrigation water samples collected biweekly from approximately 5 sources.
- In and around the area of remediation, ecological impact monitoring consists of monthly water level monitoring and water quality monitoring of pH, dissolved

oxygen, and temperature in surface water at eight locations monthly and one location hourly.

- Researchers from Kansas State University have been retained to conduct a study of the effect of EDB on cranberry plants and fruit. They will be investigating the concentration and rate of accumulation of EDB in cranberries.
- Compensation to landowners and cranberry growers is being provided for not producing their crop during the 1998 and 1999 seasons. Enactment of House of Representatives Bill 3579 (Sec. 10(g)(1), Emergency Appropriations Act for Fiscal Year 1998) provided funding and authorization for this compensation.

## 2.3 ROLE OF FEDERAL, STATE AND LOCAL AUTHORITIES

As directed by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and the FFA (under CERCLA §120), AFCEE is the lead agency for the cleanup, and EPA provides oversight of investigative and remedial actions performed at MMR (EPA et al. 1991, 1996). The Commonwealth of Massachusetts and the town of Falmouth are providing assistance to the Air Force in planning and conducting ongoing and the proposed removal actions. The Massachusetts DEP and DPH have advised AFCEE of the potential risks resulting from exposure to EDB-contaminated ground and surface waters, and the potential volatilization of EDB into the atmosphere from surface waters and spray irrigation. The Commonwealth and representatives from four surrounding towns serve in an advisory capacity to the EPA.

The town of Falmouth owns most of the land in the affected area south of Hatchville Road where the bogs are located. The town-owned land is leased on a long-term basis by the Falmouth Conservation Commission to a cranberry grower. The Conservation Commission has granted rights of access to the bogs and adjacent land to the Air Force and its contractors to conduct studies and removal activities. Other bogs along the Coonamessett River are privately owned and operated.

The town assisted AFCEE in the extension of water supply mains in Hatchville. The town managed the connection of residences and business to the mains, and provided design assistance and oversight of construction. The Air Force reimbursed the town for its expenses. The town has also provided technical assistance during the design and

construction of the GAC system at the CWSW, and continues to assist AFCEE in operation and maintenance of the GAC system.

### 2.3.1 Defense Environmental Restoration Program

The U.S. Department of Defense's statutory authority for the Air Force's Installation Restoration Program is the Defense Environmental Restoration Program (DERP) (10 U.S.C. §2701 et seq.). Among other goals, DERP authorizes a defense program to accomplish the following:

- "(1) The identification, investigation, research and development, and clean-up of contamination from hazardous substances, pollutants, and contaminants."
- "(2) Correction of other environmental damage...which creates an imminent and substantial endangerment to the public health or welfare or to the environment." 10 U.S.C. §2701(b)(1)-(2).

This statute gives the Department of Defense authority independent of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) to carry out a cleanup program.

### 2.3.2 Comprehensive Environmental Response and Compensation Liability Act

Because EDB was an additive to aviation gasoline, the contamination from FS-28 is probably related to a fuel-spill site. The contamination is considered petroleum for purposes of CERCLA's definition of "hazardous substances" (42 U.S.C. §9601(14)). Therefore, CERCLA provides no authority for the bog separation project since CERCLA specifically excludes petroleum contamination. Because CERCLA does not apply, the permit exemption provision of CERCLA ("No Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely onsite..." (42 U.S.C. §9621(e)(1)) does not apply. Thus, permits must be obtained for any regulated activity proposed for this action.

At MMR, AFCEE and EPA have agreed to amend the FFA to include the authority of Section 7003 of the Resource Conservation and Recovery Act to ensure that cleanup of petroleum sites is covered under the amended document.

### 2.3.3 State and Local Actions to Date

Various state and local agencies have written letters concerning EDB to EPA and AFCEE during the past few years. The following is a summary of the Commonwealth's actions:

- The Massachusetts DEP issued a letter on February 22, 1996, directing that the CWSW be shut down until wellhead treatment was installed. Since the Coonamessett well comprises nearly 20 percent of the town's total water supply, it is needed to meet the summer tourist demand. Wellhead treatment was installed and operational by July 1996, and the state gave conditional approval for its use in the public water supply system.
- DPH issued a letter to AFCEE in November 1996, concerning the degradation of EDB to vinyl bromide. AFCEE completed a method detection limit study for vinyl bromide and the contract laboratory was able to detect vinyl bromide at 0.01 µg/L. The contract laboratory has not detected any vinyl bromide in samples taken from the FS-28 plume. Vinyl bromide has been added to the standard suite of analysis and all samples continue to be evaluated for vinyl bromide.
- DPH issued a letter to AFCEE in December 1996, concerning the flooding of the cranberry bogs for winter protection. AFCEE prepared a risk assessment that showed limited risk from flooding of the bogs. DPH used this risk assessment and other information to conclude that flooding the bogs over the winter would not present a public health concern. DPH asked AFCEE to identify homes that had experienced flooding and to take steps to prevent this from happening. AFCEE identified one home that could be flooded, and completed sampling beneath the basement, and sealed the open hole in the concrete foundation. AFCEE also installed piezometers between the home and the river to determine the depth of the water table during flooding. Because of the proximity and elevation of the active bogs, the basement of this home continues to be impacted when the East Thompson bog is flooded. AFCEE has worked with the town and cranberry grower to address this situation. Water samples have not shown any EDB contamination in the basement when flooded.
- DPH issued a letter to AFCEE dated March 6, 1997, concerning possible inhalation exposure during spray irrigation and other bog operations. DPH requested the establishment of an aggressive ongoing environmental monitoring program for water, air, and cranberry fruit. In response, AFCEE issued a letter to DPH on

March 26, 1997, providing an outline of the proposed sampling and remedial actions to be performed in the cranberry bogs surrounding the Coonamessett River where EDB is discharging to the surface.

- Representatives from the Massachusetts Senate issued a letter to AFCEE on March 19, 1997, requesting action be taken to protect the human health as well as the agricultural crops along the Coonamessett River Valley.
- Following a review of the AFCEE plan submitted on March 26, 1997, DPH issued a letter to AFCEE dated April 7, 1997, which outlined areas of the proposed plan that DPH felt did not adequately address uncertainties regarding the distribution of and the risk from EDB in the cranberry bogs. Furthermore, DPH reiterated its position on supplying alternate water supplies to the agricultural growers along the river.
- A Notice of Responsibility was issued by the DEP on April 19, 1997, which directed AFCEE to do the following:
  - Assess the current and future impact of EDB-contaminated groundwater on the cranberry bogs along the Coonamessett River, including the soil, vines, fruit, and cultivation.
  - Immediately provide a source of clean, uncontaminated irrigation water for the affected bogs, and take steps to eliminate all EDB pathways through the contaminated irrigation wells.
  - Provide a clean source of irrigation water for all downstream and downgradient users of irrigation water.
  - Install an extraction, treatment, and reinjection (ETR) system to capture and clean EDB-contaminated groundwater and surface water prior to discharge to the Coonamessett River, including but not limited to any affected surface waters in the affected bog areas. The groundwater remediation goals shall be 100-percent capture and cleanup of the plume, and treatment of contaminants to background levels, if technically and economically feasible.
  - Conduct weekly monitoring of irrigation well water and surface water.
  - Conduct continuous ambient air monitoring at the affected bogs and reservoirs.
- The EPA and DEP approved the installation and operation of a treatment system consisting of an extraction well (EW-1), carbon filtration, and discharge of treated water to the Coonamessett River. The system became operational in October 1997.

From September 1996 to the end of 1997 when AFCEE was conducting field investigative work to define the leading edge of the FS-28 plume and implement the time-critical removal action, information was provided weekly to the Falmouth Conservation Commission concerning the investigation findings and proposed actions.

The Conservation Commission on several occasions granted emergency approval to install monitoring wells, irrigation wells, and an extraction well within 200 feet of the river. AFCEE also obtained approval, with conditions from the Conservation Commission, to discharge treated water to within 50 feet of the river. Due to the large extent of the investigation and remedial activities, a Request for Determination of Applicability (RDA) application, which outlined the investigation activities near the ponds and river, was submitted on November 14, 1996, by AFCEE. Emergency certification was granted by the Conservation Commission on November 21, 1996, to continue the installation of monitoring wells south of the Coonamessett Pond.

As part of the time-critical removal action, AFCEE also received approval from the Conservation Commission to construct temporary infiltration basins for the discharge of development water from the irrigation wells. Conditions of the approval include providing erosion protection and maintaining at least a 3-foot separation above the groundwater table. AFCEE submitted a Notice of Intent (NOI) application for the work involved with the two river crossings for the water main extensions on Hatchville Road and Thomas B. Landers Road. AFCEE also submitted an RDA for the power lines that need to be brought into the site for the extraction, treatment, and discharge (ETD) system. The NOI and RDA applications were prepared in accordance with state and local guidance; however, since the alternate water and ETD system actions are being taken as CERCLA response actions, no permits are required, as specified in the NCP.

A memorandum of agreement (MOA) was signed between the town of Falmouth and Jacobs Engineering (the lead remediation contractor for AFCEE at MMR) on April 29, 1997, concerning the residential hookups for over 85 residences and one commercial business in the Hatchville area. The MOA described the work to be completed by the town in connecting the over 85 users and eliminating their private wells. Through Jacobs Engineering, the Air Force reimbursed the town for its expenses for construction oversight, the connections to the water mains, and the administrative costs.

Between January and December 1998, a series of meetings with stakeholders was conducted by AFCEE to develop various alternatives for the continued cleanup of the river and bogs. Representatives from the state and the town were active participants in these meetings.

AFCEE submitted a Notice of Intent on October 27, 1998, and received approval from the DEP and the town of Falmouth for the work required to install a well-point extraction system, earthen berms, and sheet piles to separate the bogs from the river and provide alternative water. The Falmouth Conservation Commission approved the project with an Order of Conditions.

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### 2.3.4 Potential for Continued State and Local Response

Both the Commonwealth and the Town of Falmouth actively participate on numerous committees, boards and groups (including the Senior Management Board, the Management Review Group, the Process Action Team, and the Technical Review and Evaluation Team) that have been formally chartered to ensure that the concerns of affected communities and the state are addressed by the Air Force's response activities. It is assumed that both the state and the town will continue their current involvement.

## 3.0 THREATS TO PUBLIC HEALTH OR WELFARE, AND THE ENVIRONMENT

Section 104 of CERCLA and Section 300.415 (b)(2) of the NCP identify the criteria that must be considered in determining the appropriateness of a contaminant removal action. If the current or potential impacts meet the criteria and warrant appropriate removal actions, the actions must minimize, stabilize, mitigate, or eliminate the threat of the release of a contaminant of concern to the environment. The following paragraphs address the threats to public health or welfare and the environment.

### 3.1 THREATS TO PUBLIC HEALTH OR WELFARE

The impacts of the FS-28 plume on public health or welfare that would be addressed by removal action are as follows:

- Potential exposure of recreational users and agricultural workers involved in the growing and harvesting of cranberries in the bogs along the Coonamessett River which flows through the Hatchville area.
- Potential exposure of the cranberry fruit to EDB-contaminated water. It should be emphasized that the vines and fruit are not exposed to the Coonamessett River except during flooding. Typically, the bog operators try to keep the water level at least 16 inches below the plants. The only time the plants would be impacted is during flooding or spray irrigation.

The objectives, as outlined in the EE/CA, are to protect human health by reducing exposure to EDB occurring in the surface water, groundwater, and cranberry bogs while minimizing impacts to the ecological system, and to accelerate the restoration of the Coonamessett River.

### 3.2 THREATS TO THE ENVIRONMENT

The proposed removal actions will further reduce the discharge of EDB to surface waters over existing conditions and preclude the use of contaminated surface water for flooding. The potential impacts to the environment that will be reduced by the removal actions include potential impacts to the estuarine and marine environments since the

river discharges directly into Great Pond, and potential impacts to the ecological receptors residing in the bogs along the Coonamessett River.

## 4.0 ENDANGERMENT DETERMINATION

An endangerment determination was made in the *Time-Critical Removal Action Memorandum* which consisted primarily of deriving site-specific risk equivalent concentrations (RECs) for human exposure to EDB in surface water (AFCEE 1997b, 1999a). Subsequently, a baseline risk assessment for this area was completed for the final SWOU RI (AFCEE 1999b). A summary of that risk assessment is presented here. Additionally, the RECs for EDB in surface water have been recalculated using exposure parameters consistent with the final RI, except that a fish ingestion scenario was included using a bioconcentration factor for EDB in fish equal to 10 mg/kg wet fish per mg/L water. A more detailed discussion of the risk assumptions and calculations is presented in the final SWOU RI report (AFCEE 1999b).

The SWOU baseline risk assessment concluded that the risk of exposure to EDB in surface water and sediment exceeded guidance risk thresholds ($1x10^{-6}$ excess cancer risk) for wading scenarios for adults and children, fishing scenarios, and a work-related exposure scenario for adult cranberry workers. Risks from future exposure to EDB in groundwater were also found. However, there are no known remaining residences that continue to use groundwater following the installation of public water lines.

For this document, a recreational swimmer in Pond 14 was also considered, and risk-based concentrations were calculated for all receptors. The maximum exposure frequency was assumed to be 350 days per year for fish consumption, 104 days a year for wading, 60 days a year for swimming, and 18 days a year for cranberry workers. The exposed dermal surface area was assumed to include the hands, forearms, and lower legs for wading adults, cranberry workers, and children. The assumed exposure time was 1 hour a day for wading, 2.6 hours a day for swimming and 8 hours a day for cranberry workers.

To evaluate the relative importance of the various exposure pathways, RECs were calculated with three exposure pathways (surface water ingestion, dermal absorption,

and inhalation) for each scenario (i.e., wading, working in a bog, swimming in Pond 14, and fish ingestion) (Table 4-1). The integrated receptor is a combination of the cranberry worker, child wader, adult wader, and adult fisher.

Drilling conducted in 1998 discovered that EDB was present at concentrations greater that 15 μg/L at locations downgradient of EW-1, and shallow groundwater sampling in the area of groundwater upwelling also measured EDB at similar concentrations. The data indicated the potential for continued surface water contamination if no actions were taken.

# 5.0 PROPOSED ACTIONS AND ESTIMATED COSTS

Proposed actions included in this Non-Time-Critical Removal Action Memorandum are of two types. One type involves actions that directly reduce the risk to human or ecological receptors. The other type involves sampling and analysis programs that will be used for risk management.

## 5.1 PROPOSED ACTIONS

The proposed actions to mitigate or manage risk from the discharge of EDB to the surface environment along the Coonamessett River are as follows:

- Active treatment with the goal of reducing the concentrations of EDB in the surface water leaving the Baptiste Bog. Active treatment includes extracting groundwater from shallow well-points within the area of upwelling in addition to continued operation of the existing extraction well (EW-1) and treatment in the existing FS-28 treatment plant. The existing treatment plant may be expanded if necessary.
- Providing the surface water agricultural users with an alternate water supply by installing a pipeline along existing roads from the existing treatment facility to the bogs.
- Separation of active bogs from the Coonamessett River using newly constructed berms or sheet piles.
- Continued ecological sampling and analysis to evaluate the impacts of groundwater extraction, treatment, and discharge on the environment.
- Continued sampling and analysis of surface water, groundwater, and air samples from the Coonamessett River to manage risk and evaluate the performance of treatment until a final remedy is selected and implemented.

Figure 5-1 shows the primary components of the proposed response actions. The following section describes each of the actions that have been or will be undertaken by AFCEE.

### 5.1.1 Proposed Action Description

This section outlines the actions that will be taken to mitigate the human health and the actions that will be taken to evaluate and manage risk to the environment. Sampling

will be done to evaluate the distribution of EDB in the groundwater, surface water, and air, in the vicinity of the cranberry bogs where the FS-28 plume is discharging to the surface environment. The periodic monitoring of surface water and groundwater is designed to take advantage of the existing installed wells and surface water stations downgradient of the plume, and to use these points to provide an early warning if downgradient receptors are threatened by changes in the nature or the extent of EDB contamination.

#### 5.1.1.1 Active Treatment to Reduce EDB Concentrations in the River

Active treatment will be implemented to reduce the concentrations of EDB in the surface water leaving the Lower Baptiste Bog. Active treatment includes extracting groundwater from shallow well-points within areas of upwelling. Shallow well-points consist of screens and risers that are installed into the shallow groundwater using a high pressure water jetting procedure. Water is extracted from the well-points using a central high vacuum pump located aboveground along the edge of the bog. The contaminated water will then be conveyed and treated at the existing FS-28 treatment system using granular-activated carbon and then discharged back to the river. The goal of active treatment is to lower the EDB concentrations in surface water to less than 0.04 µg/L in the Baptiste Bog, and to achieve non-detectable concentrations entering Pond 14. Achieving non-detect levels for EDB in surface water within the Lower Baptiste Bog may not be technically or economically feasible. The reason for this is because although all extracted water can be effectively treated to remove all detectable levels of EDB, it may not be feasible to capture 100 percent of the EDB-contaminated water which is upwelling in the river, bogs, and associated irrigation ditches. The following are the major features of the active treatment response action:

- Continued operation of the EW-1 groundwater extraction and treatment system but reduced flow from EW-1 from 600 gpm to 400 gpm.
- Installation of shallow well-points (approximately 204) in Lower Baptiste Bog to capture upwelling of contaminated groundwater.

- Groundwater extraction from shallow well-points at a rate of 350 gpm to achieve a decrease in EDB concentrations in Coonamessett River leaving the Baptiste Bog.

Figure 5-2 shows the general site plan for the active extraction and treatment system described above.

#### 5.1.1.2 Alternative Source of Water

To avoid using potentially contaminated river water for cranberry operations in the upper bogs, treated water from the existing EW-1 treatment plant will be used. A pipeline from the treatment facility to the bogs will be constructed on existing bog roads and will include a series of valves to control each of the six alternate discharge points. The six alternate discharge points will allow individual control of flow to each of the bogs for flooding. The pipeline will be approximately 3,800 feet in length and will include six different locations to discharge the treated water into the bogs. The pipe will be constructed of high density polyethylene and will be installed at least 3 feet below the ground surface. One road crossing at Thomas B. Landers Road is required. Vertical bubblers, similar to the system presently in use on the Coonamessett River, will be used to discharge treated water into the bogs. The bubblers serve two important functions: they add oxygen to the water and reduce potential erosion at the discharge point.

#### 5.1.1.3 Separate Active Bogs from the River Using Berms or Vinyl Sheet Piles

Four of the upper bogs (Baptiste, Adams, Lasalle, and East Thompson) will be separated from the river using berms or sheet piles to prevent contaminated surface water from flowing into the bogs. If the bogs are separated using an earthen berm, the berm will be constructed entirely on the active bog area. Because the river runs through East Thompson bog, the berm will be constructed on the east side of the river. The west side of this bog, approximately 1.2 acres, will become inactive except for periodic maintenance (tree removal, for example) until the Coonamessett River is no longer contaminated. The eastern side of the bog would be kept as an active cranberry

bog. Placing a berm on the east side of the river may also reduce the flooding of a nearby abutting landowner.

The berms will have a minimum width of 8 feet and side slopes no steeper than 2 (horizontal) to 1 (vertical). They will be approximately 3 to 4 feet in height with flumes installed for bog drainage. The berms will be topped with gravel for access, and the sides will be vegetated.

Vinyl sheet piles are also being considered as a way to separate the bogs from the river system (particularly the Adams and Lasalle bogs). The vinyl sheet piles reduce the surface area of the bog that would be lost by constructing a berm, but do not allow for vehicle access around the perimeter of the bog. The sheet piles are designed for aquatic environments and are manufactured from inert, recycled plastic. The sheet piles will be installed by a rubber-tired backhoe. The piles will extend approximately 8 to 10 feet into the ground and protrude 2 to 3 feet above ground surface. The major feature of the bog-river separation response action is the construction of either earthen berms or sheet piles to separate the active bog from the river system.

#### 5.1.1.4 Ecological System Monitoring

The monitoring of water levels and physicochemical, chemical, and biological parameters is discussed in the *FS-28 Monitoring Plan* (AFCEE 1998b).

### 5.1.2 Contribution to Remedial Performance

All of the ongoing and proposed removal actions are considered to be complementary to and consistent with any final long-term remedial action that may be implemented for the FS-28 plume. Studies conducted to date have determined that EDB will continue to discharge from the groundwater into the surface waters of the Coonamessett and Broad rivers for several years. Therefore, the response action contributes to the elimination of potential exposures consistent with anticipated long-term remedial actions.

The removal actions proposed in this Non-Time-Critical Removal Action Memorandum will address the immediate threat of exposure to EDB in the Coonamessett River and associated bogs. Both ecological receptors and human receptors may be exposed to EDB as described in Section 3.0, if actions are not taken to mitigate the risks. The proposed actions will provide protection from these risks until the final remedy is chosen and implemented.

### 5.1.3 Engineering Evaluation and Cost Analysis

Several alternatives were considered to remediate EDB discharging to the Coonamessett River and associated cranberry bogs. The EE/CA provides a detailed description and evaluation of the alternatives that were considered (AFCEE 1998c). The evaluation followed EPA guidance for non-time-critical removal actions (EPA 1993). Six alternatives were considered for the Coonamessett River as follows:

| | |
|---|---|
| **Alternative A:** | Limited Action with Institutional Controls |
| **Alternative B:** | Channel Realignment and Passive Treatment of Groundwater |
| **Alternative C1:** | Channel Realignment and Active Treatment of Groundwater |
| **Alternative C2:** | Active Treatment of Groundwater with No Channel Realignment |
| **Alternative D:** | Separate and Isolate All Downstream Bogs |
| **Alternative E:** | Phased Approach: Active Treatment of Groundwater, Separate Bogs from River, Provide Treated Water to Bogs. |

Alternative E, the phased approach, is the preferred alternative that is presented as the proposed action in this Non-Time-Critical Removal Action Memorandum (Figure 5-1). A public comment period on the EE/CA occurred from November 30 to December 21, 1998. A public hearing to discuss the alternatives was hosted by AFCEE on December 10, 1998. Three oral public comments were heard during the public meeting and two written comments were received before the comment period ended. AFCEE responses to these comments are provided as Appendix A.

### 5.1.4 Applicable or Relevant and Appropriate Requirements

Table 5-1 presents the applicable or relevant and appropriate requirements for the FS-28 plume response actions.

### 5.1.5 Project Schedule

Figure 5-3 presents the project schedule for response actions that are being conducted and proposed for the FS-28 plume.

## 5.2 ESTIMATED COSTS

The estimated cost of the response actions presented in this Non-Time-Critical Removal Action Memorandum ranges from $1.7 million to $4.9 million, depending on whether the existing FS-28 treatment plant requires expansion. This cost includes engineering, sampling, and analysis.

## 6.0 EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

The ongoing and proposed actions are designed to mitigate the exposure and potential exposure to a release or releases of EDB into the environment from undetermined sources during the past 50 years. Because the response actions are not designed to stop or prevent a release, failure to take these actions or to delay any of them will not mitigate the environmental degradation that currently exists.

Without the continued operation of the GAC system on the CWSW, the town of Falmouth could experience severe water shortages in the event of a major fire or during the tourist season, thus compromising public health and welfare. If an alternative water supply for flooding is not installed to provide clean water for agricultural purposes, there is a public perception that the fruit, harvested by users of surface water, may be compromised. In addition, without the continued monitoring of EDB concentrations in groundwater, surface water, and GAC effluent, the EDB exposure to receptors residing near and working in the affected bogs cannot be measured, and the risk from exposure cannot be managed using engineering or institutional controls.

Because November 1998 field investigations determined that relatively high (18 μg/L) concentrations of EDB are present in deep groundwater upgradient of the area where the plume is discharging to the surface environment, concentrations of EDB in the surface water may increase significantly if no actions are taken, resulting in increased potential human health risks.

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## 7.0 OUTSTANDING POLICY ISSUES

There are no identified policy issues that must be resolved prior to implementation of the proposed removal actions.

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## 8.0 ENFORCEMENT

As stated in the NCP, section 300.415(a)(2), EPA's policy concerning removal enforcement states that when potentially responsible parties are known, an effort shall be made, to the extent practicable, to determine whether they can and will perform the necessary removal action promptly and properly. At this time, the Department of Defense is considered the potentially responsible party for the FS-28 site. However, a definite source of the FS-28 plume at MMR has not been established, and it is likely that no site can be linked with certainty.

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## 9.0 RECOMMENDATIONS

This decision document representes the selected non-time-critical removal action for the distal portion of the FS-28 plume in Falmouth, Massachusetts, developed in accordance with CERCLA as amended and consistent with the NCP. This decision is based on the administrative record for the site. The proposed response actions previously described meet the NCP criteria for a removal set forth in section 300.415(b)(2). The actions have been designed first to be protective of public health and welfare, and second to protect the environment. Those items that are protective of public health include the following:

- Continued operation, maintenance and sampling of the CWSW. This also includes engineering of a permanent system to control the fouling of the CWSW's GAC.
- Active treatment with the goal of reducing the concentrations of EDB in the surface water leaving the Baptiste Bog. Active treatment includes extracting groundwater from shallow well-points within the area of upwelling in addition to the continued operation of the existing extraction well (EW-1) and treatment in the existing FS-28 treatment plant. The existing treatment plant may be expanded if necessary.
- Providing the surface water agricultural users with an alternate water supply by installing a pipeline along existing roads from the existing treatment facility to the bogs.
- Separation of active bogs from the Coonamessett River using newly constructed berms or sheet piles.
- Continued ecological sampling and analysis to evaluate the impacts of groundwater extraction, treatment, and discharge on the environment.
- Continued sampling and analysis of surface water, groundwater, and air samples (if necessary) from the Coonamessett River to manage risk and evaluate performance of treatment until a final remedy is implemented.
- Completing the SWOU RI/FS for the entire plume to select a final remedy.

Conditions at the site meet the NCP section 300.415(b)(2) criteria for a removal and we recommend approval of the proposed removal action.

Jim Snyder
Remedial Program Manager, AFCEE

11/17/99
Date

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## 10.0 REFERENCES


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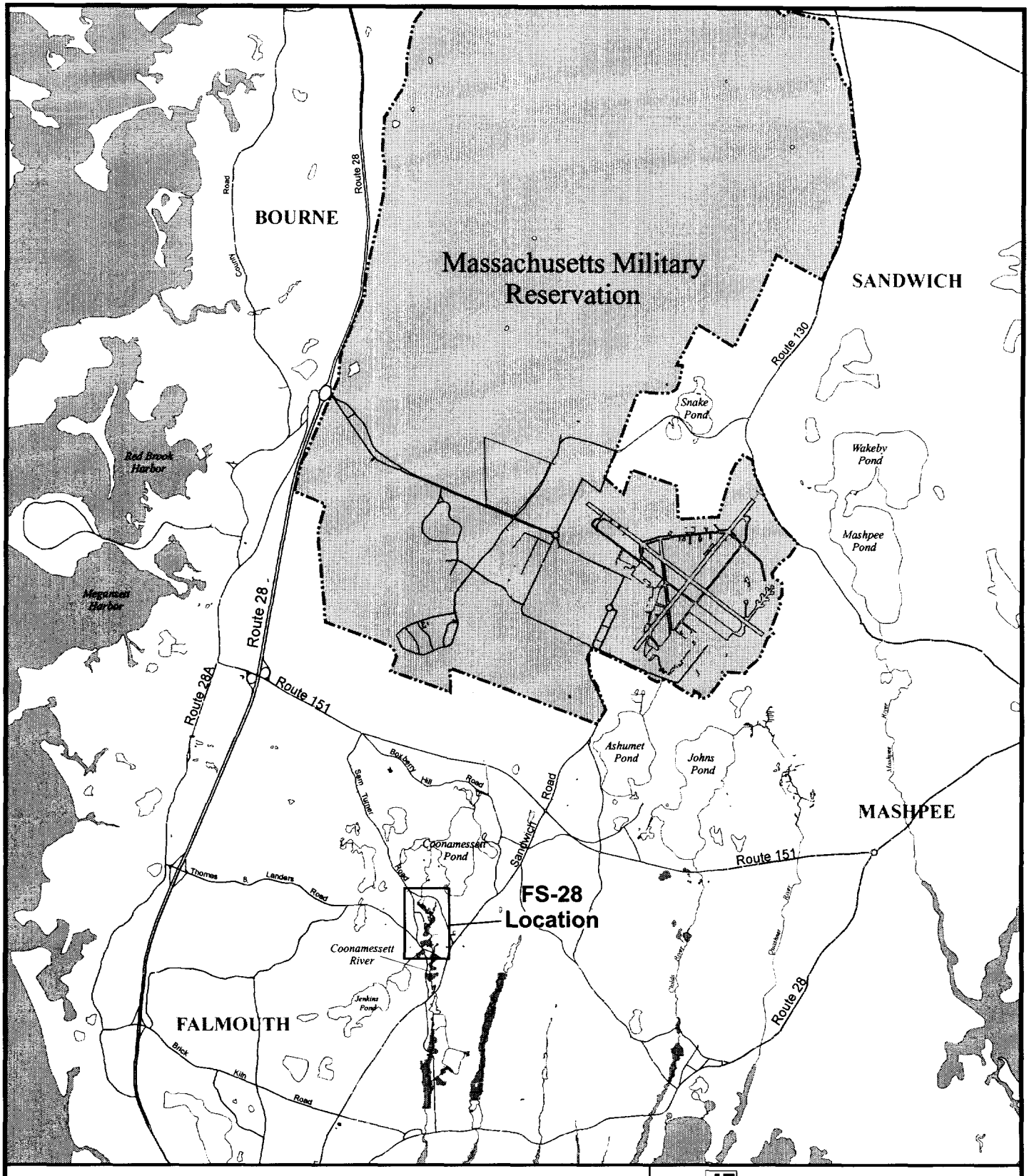
# FIGURES



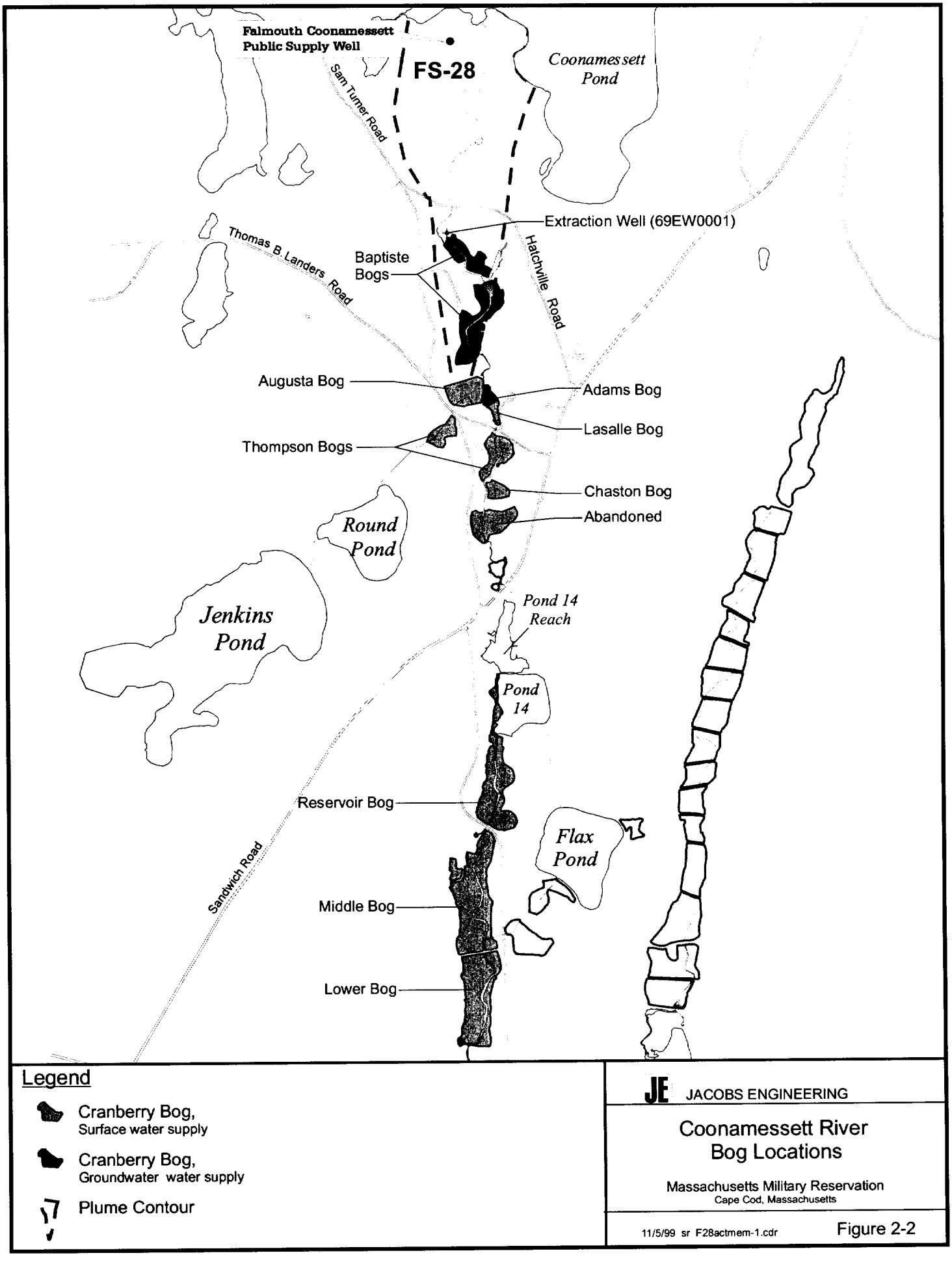

JE JACOBS ENGINEERING

# FS-28 Location

Massachusetts Military Reservation
Cape Cod, Massachusetts

10/29/99 kk F28actmem-3.cdr

Figure 2-1


Falmouth Coonamessett
Public Supply Well
FS-28
Coonamessett
Pond
Sam Turner Road
Extraction Well (69EW0001)
Thomas B. Landers Road
Baptiste
Bogs
Hatchville Road
Augusta Bog
Adams Bog
Lasalle Bog
Thompson Bogs
Chaston Bog
Abandoned
Round
Pond
Jenkins
Pond
Pond 14
Reach
Pond
14
Reservoir Bog
Flax
Pond
Sandwich Road
Middle Bog
Lower Bog
Legend
Cranberry Bog,
Surface water supply
Cranberry Bog,
Groundwater water supply
Plume Contour
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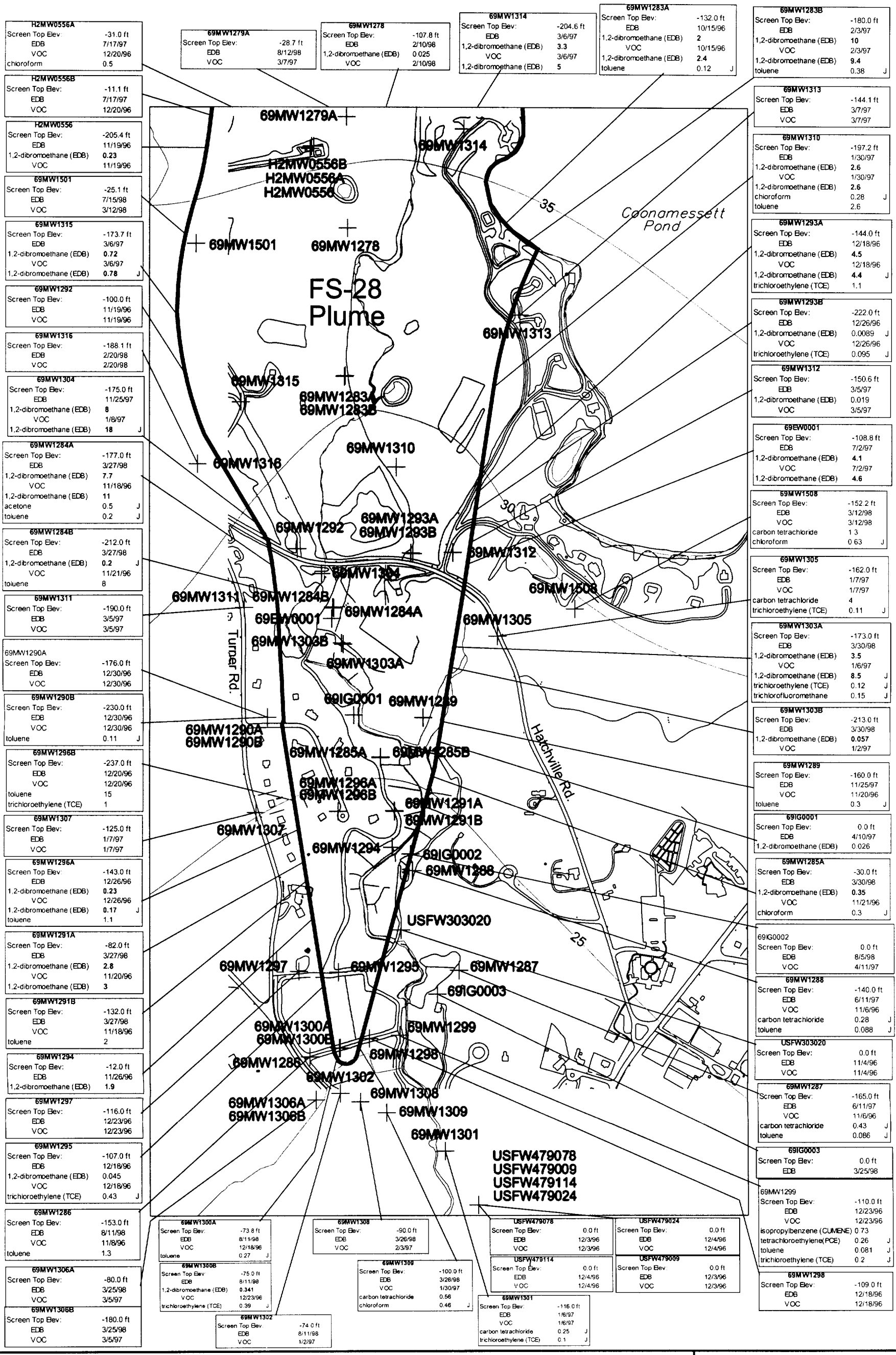
Coonamessett River
Bog Locations
Massachusetts Military Reservation
Cape Cod, Massachusetts
11/5/99 sr F28actmem-1.cdr
Figure 2-2




**H2MW0556A**
Screen Top Elev: -31.0 ft
EDB 7/17/97
VOC 12/20/96
chloroform 0.5

**H2MW0556B**
Screen Top Elev: -11.1 ft
EDB 7/17/97
VOC 12/20/96

**H2MW0556**
Screen Top Elev: -205.4 ft
EDB 11/19/96
1,2-dibromoethane (EDB) **0.23**
VOC 11/19/96

**69MW1501**
Screen Top Elev: -25.1 ft
EDB 7/15/98
VOC 3/12/98

**69MW1315**
Screen Top Elev: -173.7 ft
EDB 3/6/97
1,2-dibromoethane (EDB) **0.72**
VOC 3/6/97
1,2-dibromoethane (EDB) **0.78** J

**69MW1292**
Screen Top Elev: -100.0 ft
EDB 11/19/96
VOC 11/19/96

**69MW1316**
Screen Top Elev: -188.1 ft
EDB 2/20/98
VOC 2/20/98

**69MW1304**
Screen Top Elev: -175.0 ft
EDB 11/25/97
1,2-dibromoethane (EDB) **8**
VOC 1/8/97
1,2-dibromoethane (EDB) **18** J

**69MW1284A**
Screen Top Elev: -177.0 ft
EDB 3/27/98
1,2-dibromoethane (EDB) **7.7**
VOC 11/18/96
1,2-dibromoethane (EDB) **11**
acetone 0.5 J
toluene 0.2 J

**69MW1284B**
Screen Top Elev: -212.0 ft
EDB 3/27/98
1,2-dibromoethane (EDB) **0.2** J
VOC 11/21/96
toluene 8

**69MW1311**
Screen Top Elev: -190.0 ft
EDB 3/5/97
VOC 3/5/97

69MW1290A
Screen Top Elev: -176.0 ft
EDB 12/30/96
VOC 12/30/96

**69MW1290B**
Screen Top Elev: -230.0 ft
EDB 12/30/96
VOC 12/30/96
toluene 0.11 J

**69MW1296B**
Screen Top Elev: -237.0 ft
EDB 12/20/96
VOC 12/20/96
toluene 15
trichloroethylene (TCE) 1

**69MW1307**
Screen Top Elev: -125.0 ft
EDB 1/7/97
VOC 1/7/97

**69MW1296A**
Screen Top Elev: -143.0 ft
EDB 12/26/96
1,2-dibromoethane (EDB) **0.23**
VOC 12/26/96
1,2-dibromoethane (EDB) **0.17** J
toluene 1.1

**69MW1291A**
Screen Top Elev: -82.0 ft
EDB 3/27/98
1,2-dibromoethane (EDB) **2.8**
VOC 11/20/96
1,2-dibromoethane (EDB) **3**

**69MW1291B**
Screen Top Elev: -132.0 ft
EDB 3/27/98
VOC 11/18/96
toluene 2

**69MW1294**
Screen Top Elev: -12.0 ft
EDB 11/26/96
1,2-dibromoethane (EDB) **1.9**

**69MW1297**
Screen Top Elev: -116.0 ft
EDB 12/23/96
VOC 12/23/96

**69MW1295**
Screen Top Elev: -107.0 ft
EDB 12/18/96
1,2-dibromoethane (EDB) 0.045
VOC 12/18/96
trichloroethylene (TCE) 0.43 J

**69MW1286**
Screen Top Elev: -153.0 ft
EDB 8/11/98
VOC 11/8/96
toluene 1.3

**69MW1306A**
Screen Top Elev: -80.0 ft
EDB 3/25/98
VOC 3/5/97

**69MW1306B**
Screen Top Elev: -180.0 ft
EDB 3/25/98
VOC 3/5/97

**69MW1279A**
Screen Top Elev: -28.7 ft
EDB 8/12/98
VOC 3/7/97

**69MW1278**
Screen Top Elev: -107.8 ft
EDB 2/10/98
1,2-dibromoethane (EDB) 0.025
VOC 2/10/98

**69MW1314**
Screen Top Elev: -204.6 ft
EDB 3/6/97
1,2-dibromoethane (EDB) **3.3**
VOC 3/6/97
1,2-dibromoethane (EDB) **5**

**69MW1283A**
Screen Top Elev: -132.0 ft
EDB 10/15/96
1,2-dibromoethane (EDB) **2**
VOC 10/15/96
1,2-dibromoethane (EDB) **2.4**
toluene 0.12 J

**69MW1283B**
Screen Top Elev: -180.0 ft
EDB 2/3/97
1,2-dibromoethane (EDB) **10**
VOC 2/3/97
1,2-dibromoethane (EDB) **9.4**
toluene 0.38 J

**69MW1313**
Screen Top Elev: -144.1 ft
EDB 3/7/97
VOC 3/7/97

**69MW1310**
Screen Top Elev: -197.2 ft
EDB 1/30/97
1,2-dibromoethane (EDB) **2.6**
VOC 1/30/97
1,2-dibromoethane (EDB) **2.6**
chloroform 0.28 J
toluene 2.6

**69MW1293A**
Screen Top Elev: -144.0 ft
EDB 12/18/96
1,2-dibromoethane (EDB) **4.5**
VOC 12/18/96
1,2-dibromoethane (EDB) **4.4** J
trichloroethylene (TCE) 1.1

**69MW1293B**
Screen Top Elev: -222.0 ft
EDB 12/26/96
1,2-dibromoethane (EDB) 0.0089 J
VOC 12/26/96
trichloroethylene (TCE) 0.095 J

**69MW1312**
Screen Top Elev: -150.6 ft
EDB 3/5/97
1,2-dibromoethane (EDB) 0.019
VOC 3/5/97

**69EW0001**
Screen Top Elev: -108.8 ft
EDB 7/2/97
1,2-dibromoethane (EDB) **4.1**
VOC 7/2/97
1,2-dibromoethane (EDB) **4.6**

**69MW1508**
Screen Top Elev: -152.2 ft
EDB 3/12/98
VOC 3/12/98
carbon tetrachloride 1.3
chloroform 0.63 J

**69MW1305**
Screen Top Elev: -162.0 ft
EDB 1/7/97
VOC 1/7/97
carbon tetrachloride 4
trichloroethylene (TCE) 0.11 J

**69MW1303A**
Screen Top Elev: -173.0 ft
EDB 3/30/98
1,2-dibromoethane (EDB) **3.5**
VOC 1/6/97
1,2-dibromoethane (EDB) **8.5** J
trichloroethylene (TCE) 0.12 J
trichlorofluoromethane 0.15 J

**69MW1303B**
Screen Top Elev: -213.0 ft
EDB 3/30/98
1,2-dibromoethane (EDB) **0.057**
VOC 1/2/97

**69MW1289**
Screen Top Elev: -160.0 ft
EDB 11/25/97
VOC 11/20/96
toluene 0.3 J

**69IG0001**
Screen Top Elev: 0.0 ft
EDB 4/10/97
1,2-dibromoethane (EDB) 0.026

**69MW1285A**
Screen Top Elev: -30.0 ft
EDB 3/30/98
1,2-dibromoethane (EDB) **0.35**
VOC 11/21/96
chloroform 0.3 J

69IG0002
Screen Top Elev: 0.0 ft
EDB 8/5/98
VOC 4/11/97

**69MW1288**
Screen Top Elev: -140.0 ft
EDB 6/11/97
VOC 11/6/96
carbon tetrachloride 0.28 J
toluene 0.088 J

**USFW303020**
Screen Top Elev: 0.0 ft
EDB 11/4/96
VOC 11/4/96

**69MW1287**
Screen Top Elev: -165.0 ft
EDB 6/11/97
VOC 11/6/96
carbon tetrachloride 0.43 J
toluene 0.086 J

**69IG0003**
Screen Top Elev: 0.0 ft
EDB 3/25/98

69MW1299
Screen Top Elev: -110.0 ft
EDB 12/23/96
VOC 12/23/96
isopropylbenzene (CUMENE) 0.73
tetrachloroethylene(PCE) 0.26 J
toluene 0.081 J
trichloroethylene (TCE) 0.2 J

**69MW1298**
Screen Top Elev: -109.0 ft
EDB 12/18/96
VOC 12/18/96

**69MW1300A**
Screen Top Elev: -73.8 ft
EDB 8/11/98
VOC 12/18/96
toluene 0.27 J

**69MW1300B**
Screen Top Elev: -75.0 ft
EDB 8/11/98
1,2-dibromoethane (EDB) **0.341**
VOC 12/23/96
trichloroethylene (TCE) 0.39 J

**69MW1302**
Screen Top Elev: -74.0 ft
EDB 8/11/98
VOC 1/2/97

**69MW1308**
Screen Top Elev: -90.0 ft
EDB 3/26/98
VOC 2/3/97

**69MW1309**
Screen Top Elev: -100.0 ft
EDB 3/26/98
VOC 1/30/97
carbon tetrachloride 0.56
chloroform 0.46 J

**USFW479078**
Screen Top Elev: 0.0 ft
EDB 12/3/96
VOC 12/3/96

**USFW479024**
Screen Top Elev: 0.0 ft
EDB 12/4/96
VOC 12/4/96

**USFW479114**
Screen Top Elev: 0.0 ft
EDB 12/4/96
VOC 12/4/96

**USFW479009**
Screen Top Elev: 0.0 ft
EDB 12/3/96
VOC 12/3/96

**69MW1301**
Screen Top Elev: -116.0 ft
EDB 1/6/97
VOC 1/6/97
carbon tetrachloride 0.25 J
trichloroethylene (TCE) 0.1 J

## Legend

- Well Location
- 35 May 1998 Water Table Contour

## Notes

Concentrations in bold exceed the lower of the Federal and State limits for drinking water standards.

All concentrations are in µg/L.

Dates are sample dates.

J = estimated

0 500
Scale in Feet

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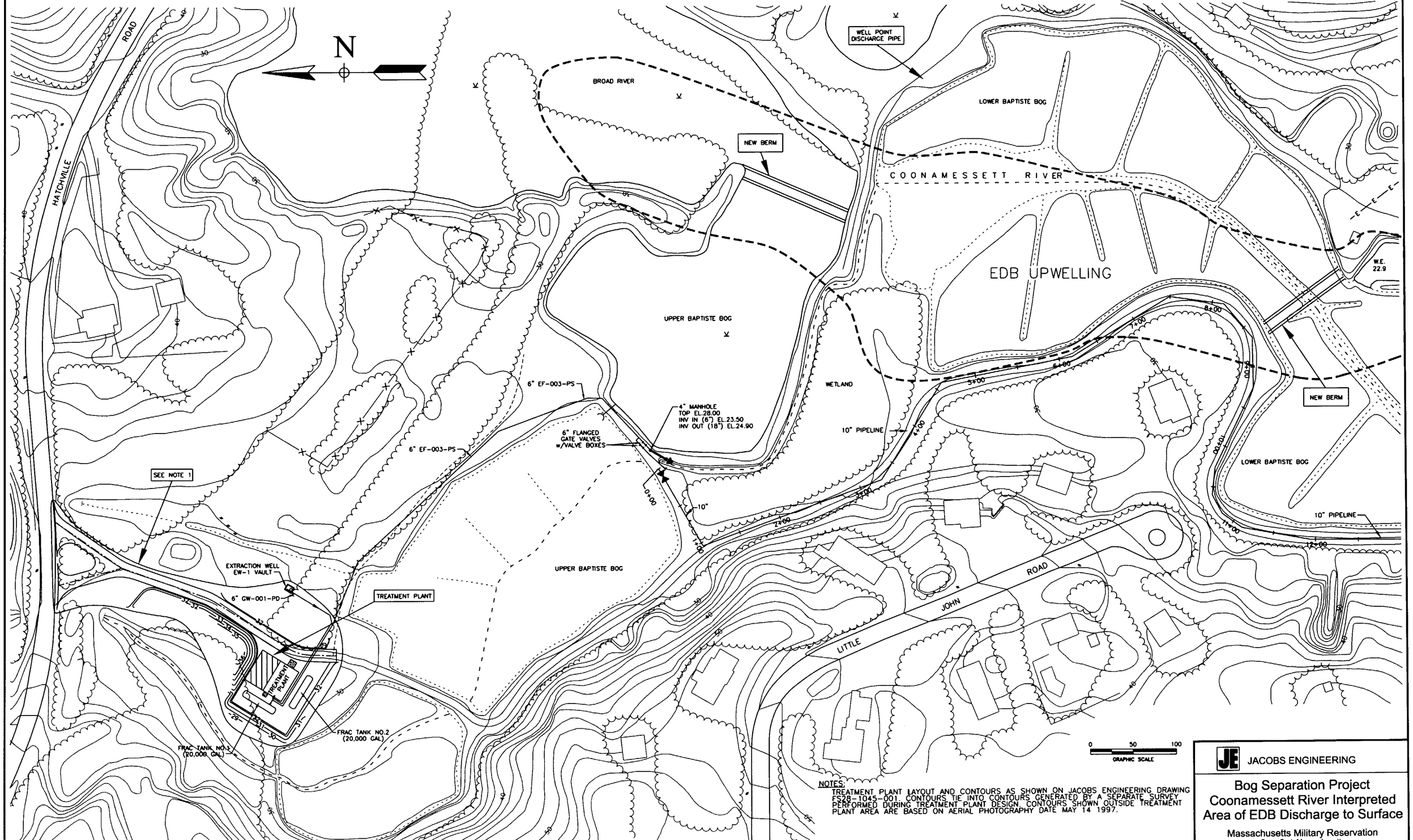
# Existing Monitoring Wells and Irrigation Wells

Massachusetts Military Reservation
Cape Cod, Massachusetts

11/16/99 sr File...7-1011.dwg

Figure 2-3




NOTES:
TREATMENT PLANT LAYOUT AND CONTOURS AS SHOWN ON JACOBS ENGINEERING DRAWING FS28-1045-001. CONTOURS TIE INTO CONTOURS GENERATED BY A SEPARATE SURVEY PERFORMED DURING TREATMENT PLANT DESIGN. CONTOURS SHOWN OUTSIDE TREATMENT PLANT AREA ARE BASED ON AERIAL PHOTOGRAPHY DATE MAY 14 1997.

REFERNCE DRAWING
FS28-1045-001 MMR PLUME RESPONSE PROJECT, FUEL SPILL-28 PLUME, SITE PLAN

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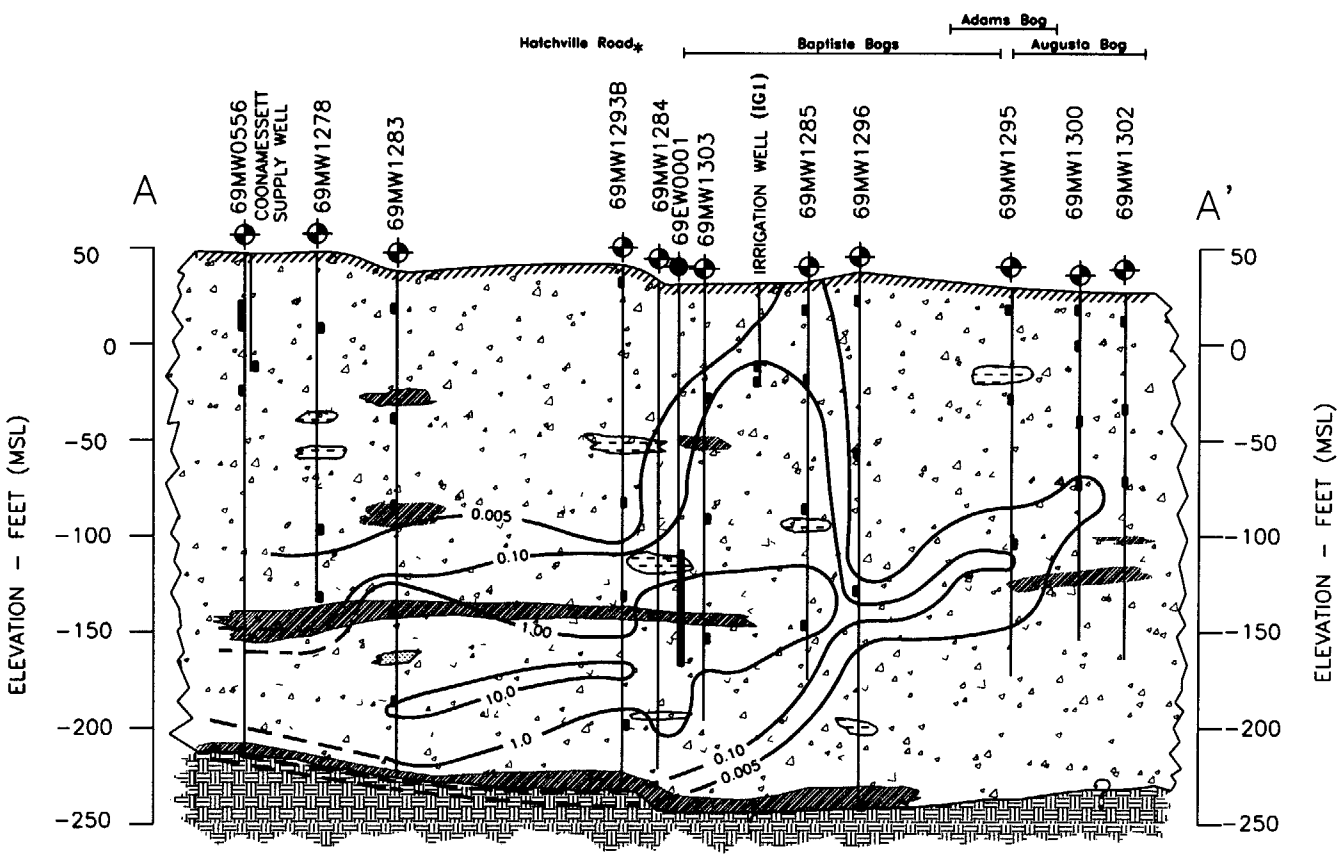
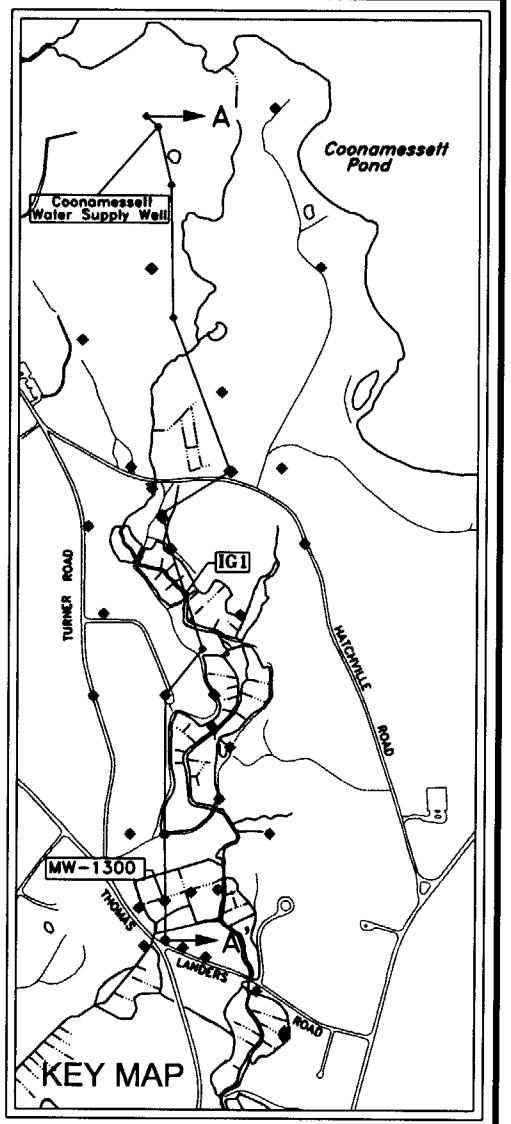
# Bog Separation Project
# Coonamessett River Interpreted Area of EDB Discharge to Surface

Massachusetts Military Reservation
Cape Cod, Massachusetts

11/8/99 sr File...actmem-5.dwg

Figure 2-4




Note: EDB Concentrations based upon sampling and analysis prior to Dec. 1996

## Legend

- Monitoring Well
- Extraction Well
- 0.02 EDB Concentration Isopleth
- ND Not Detected
- Well Screen
- Sand
- Silt
- Gravel
- Bedrock

Note:
Concentrations in µg/L

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# EDB Isoconcentration Along Cross-Section A-A' of FS-28

Massachusetts Military Reservation
Cape Cod, Massachusetts

10/29/99 kk actmem-6.dwg

Figure 2-5

# FS-28 Coonamessett River

**Upper Baptiste Bogs**
**Total: 3.5 acres**

**Upper Baptiste Bog (E1)**
- Surface water data non-detect
- Continue collecting surface water data

**Upper Baptiste Bog (E2)**
- Surface water data non-detect
- Continue collecting surface water data

**Upper Baptiste Bog (E3)**
- Berm east end of bog E3 to isolate from Broad River
- Install new flume
- Continue collecting surface water data

**Augusta Bogs (G1): 2.8 acres**
**(G2): 1.8 acres)**
- Surface water data non-detect
- Bog is already separated from river.
- Provide alternate water source from EW-1 pipeline
- Continue collecting surface water data

**West Thompson Bog (I1): 1.9 acres**
- Surface water data non-detect
- Bog is already separated from river.
- Provide alternate water source from EW-1 pipeline through Augusta bog
- Continue collecting surface water data

**Chaston Bog (J): 1.5 acres**
- Surface water data non-detect
- Bog is already separated from river
- Provide alternate water source from EW-1 pipeline
- Continue collecting surface water data

**Reservoir Bog (A): 7.8 acres**
- Improve fish ladder at outlet of Pond 14
- Continue collecting surface water data

**Middle Bog (B1 & B2): 13.6 acres**
- Continue collecting surface water data

**Lower Baptiste Bog (E4): 6.6 acres**
- Conduct Shallow Well-Point Pilot Test in upper corner of bog
- Reduce EW-1 pump rate to 400 gpm
- Treat well-point captured flow with remaining capacity of 350 gpm at EW-1 Treatment Plant with expanded well-point extraction
- Continue Collecting Surface Water Data

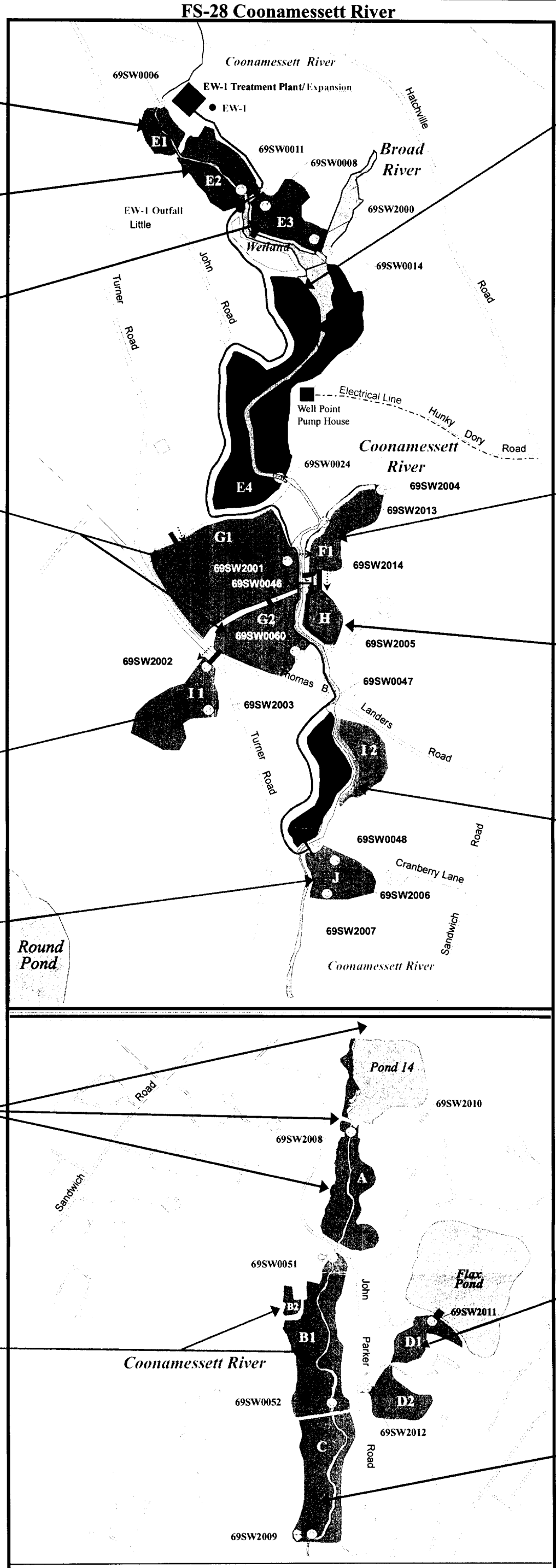
**Adams Bog (F1): 0.8 acres**
- Install berm on west side of bog to separate it from the river
- Provide alternate water source from EW-1 pipeline
- Continue collecting surface water data

**LaSalle Bog (H): 1.5 acres**
- Install sheet piling on west side of bog to separate it from the river
- Provide alternate water source from EW-1 pipeline
- Continue collecting surface water data

**East Thompson Bog (I2) 3.1 acres**
- Berm east side of river channel
- West side temporarily taken out of production
- East side remains cranberry bog
- Provide alternate water source from EW-1 pipeline
- Continue to collect surface water data

**Flax Pond Bogs (D1 & D2): 5.4 acres**
- Improve flume at Flax Pond outlet
- Continue collecting surface water data
- Test Berries, Market FY98

**Lower Bog (C): 10.6 acres**
- Surface water data non-detect
- Continue collecting surface water data

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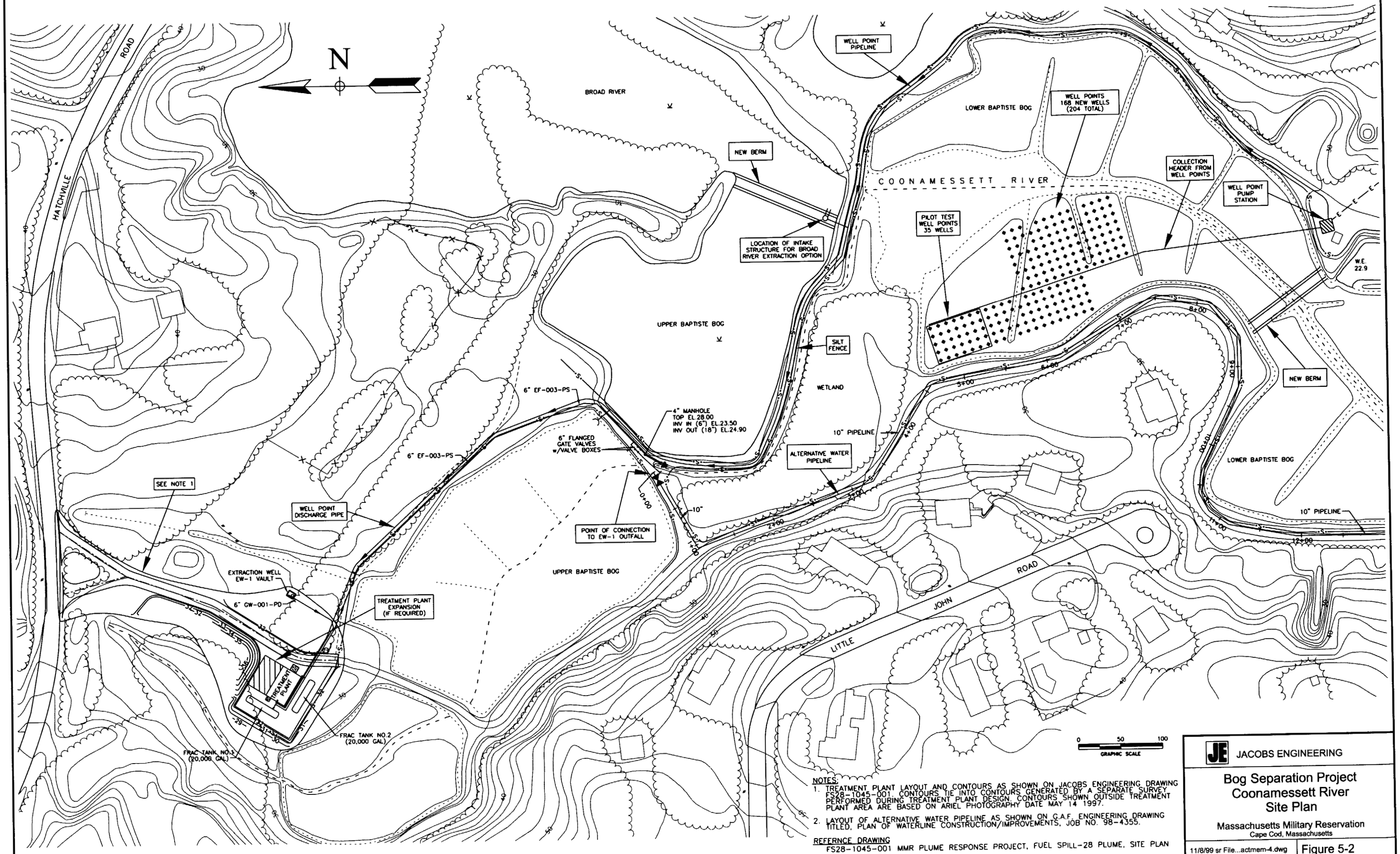
## Coonamessett River Proposed Response Actions

Massachusetts Military Reservation
Cape Cod, Massachusetts

11/8/99 sr F28actmem-2.cdr

Figure 5-1




NOTES:

1. TREATMENT PLANT LAYOUT AND CONTOURS AS SHOWN ON JACOBS ENGINEERING DRAWING FS28-1045-001. CONTOURS TIE INTO CONTOURS GENERATED BY A SEPARATE SURVEY PERFORMED DURING TREATMENT PLANT DESIGN. CONTOURS SHOWN OUTSIDE TREATMENT PLANT AREA ARE BASED ON ARIEL PHOTOGRAPHY DATE MAY 14 1997.
2. LAYOUT OF ALTERNATIVE WATER PIPELINE AS SHOWN ON C.A.F. ENGINEERING DRAWING TITLED, PLAN OF WATERLINE CONSTRUCTION/IMPROVEMENTS, JOB NO. 98-4355.

REFERNCE DRAWING

FS28-1045-001 MMR PLUME RESPONSE PROJECT, FUEL SPILL-28 PLUME, SITE PLAN

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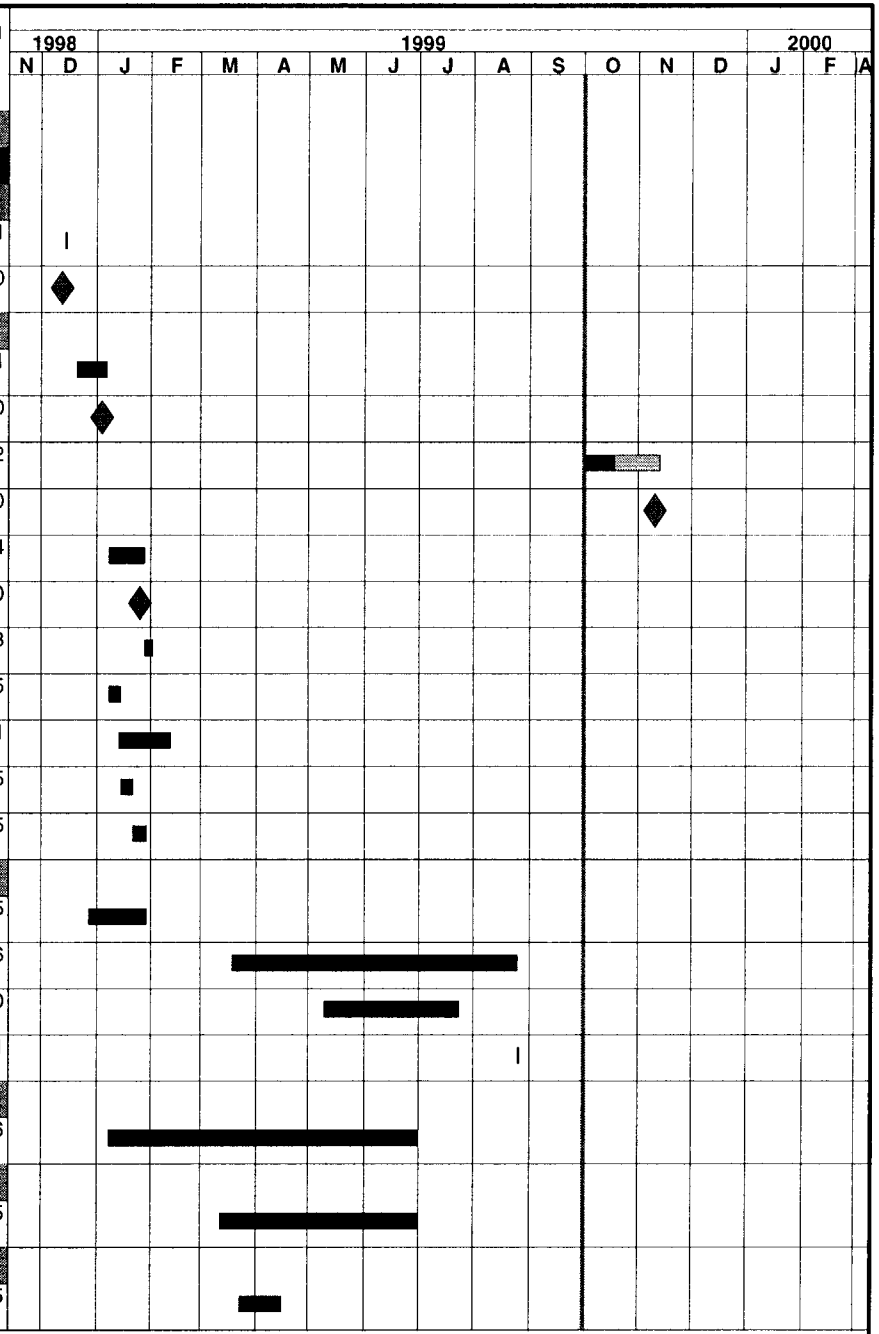
# Bog Separation Project Coonamessett River Site Plan

Massachusetts Military Reservation
Cape Cod, Massachusetts

11/8/99 sr File...actmem-4.dwg

Figure 5-2

| Activity ID | Activity Description | Early Start | Early Finish | Orig Dur |
|---|---|---|---|---|
| **DO 18** | | | | |
| **AS-S 19.03.02 COONAMESSETT BOG SEPARATION** | | | | |
| **NON-PLUME SPECIFIC** | | | | |
| **DELIVERY ORDER AWARD** | | | | |
| CRA0000A | Award Contract | 15DEC98A | 15DEC98A | 1 |
| CRA0000B | Notice To Proceed | | 15DEC98A | 0 |
| **WBS 33.01.03 PRECONSTRUCTION PLANS** | | | | |
| CRA0590C | Prepare Draft Action Memorandum | 21DEC98A | 06JAN99A | 11 |
| CRA0590D | Submit Draft Action Memorandum | | 06JAN99A | 0 |
| CRA0590H1 | Prepare Final Action Memo | 01OCT99 | 12NOV99 | 52 |
| CRA0590H2 | SUBMIT FINAL ACTION MEMO | | 12NOV99 | 0 |
| CRA0590I | PREPARE 404 CATEGORY II GENERAL PERMIT | 08JAN99A | 27JAN99A | 14 |
| CRA0590R | SUBMIT 404 CATEGORY II GENERAL PERMIT | | 27JAN99A | 0 |
| CRA0590S | CORP REVIEW/ISSUE 404 CATEGORY II GENERAL PERMIT | 28JAN99A | 01FEB99A | 3 |
| CRA0590T | PREPARE 401 WATER CERTIFICATION PERMIT | 08JAN99A | 14JAN99A | 5 |
| CRA0590U | PREPARE 401 WATER PERMIT - PUBLIC COMMENT | 14JAN99A | 11FEB99A | 21 |
| CRA0590V | SUBMIT 401 WATER CERTIFICATION PERMIT | 15JAN99A | 21JAN99A | 5 |
| CRA0590W | RECEIVE 401 WATER CERTICATION | 22JAN99A | 28JAN99A | 5 |
| **WBS 33.99.04 ENGINEERING** | | | | |
| CRA1010B | FINALIZE DESIGN | 28DEC98A | 29JAN99A | 25 |
| CRA1010N | FISH LADDER DESIGN | 19MAR99A | 24AUG99A | 36 |
| CRA1010O | PREPARE AND SUBMIT NOTICE OF INTENT | 10MAY99A | 23JUL99A | 50 |
| CRA1010O1 | NOI HEARING | 25AUG99A | 25AUG99A | 1 |
| **WBS 33.03.04 ACCESS/PERMITS** | | | | |
| CRA1505A | EASEMENTS AND PERMITS | 08JAN99A | 30JUN99A | 6 |
| **WBS 33.13.00 GENERAL - CONSTRUCTION** | | | | |
| CRA2022A | CONSTRUCT BERMS, FLUMES, AND SHEET PILES | 12MAR99A | 30JUN99A | 105 |
| **WBS 33.06.50 WELLFIELD PIPELINE - CONSTRUCTION** | | | | |
| CRA2165K | CONSTRUCT PIPELINE/PUMPHOUSE | 23MAR99A | 15APR99A | 5 |




Project Start 01DEC98
Project Finish 30MAR00
Data Date 01OCT99
Run Date 19OCT99



WORKING SCHEDULE
Progress Bar
Critical Activity

1801

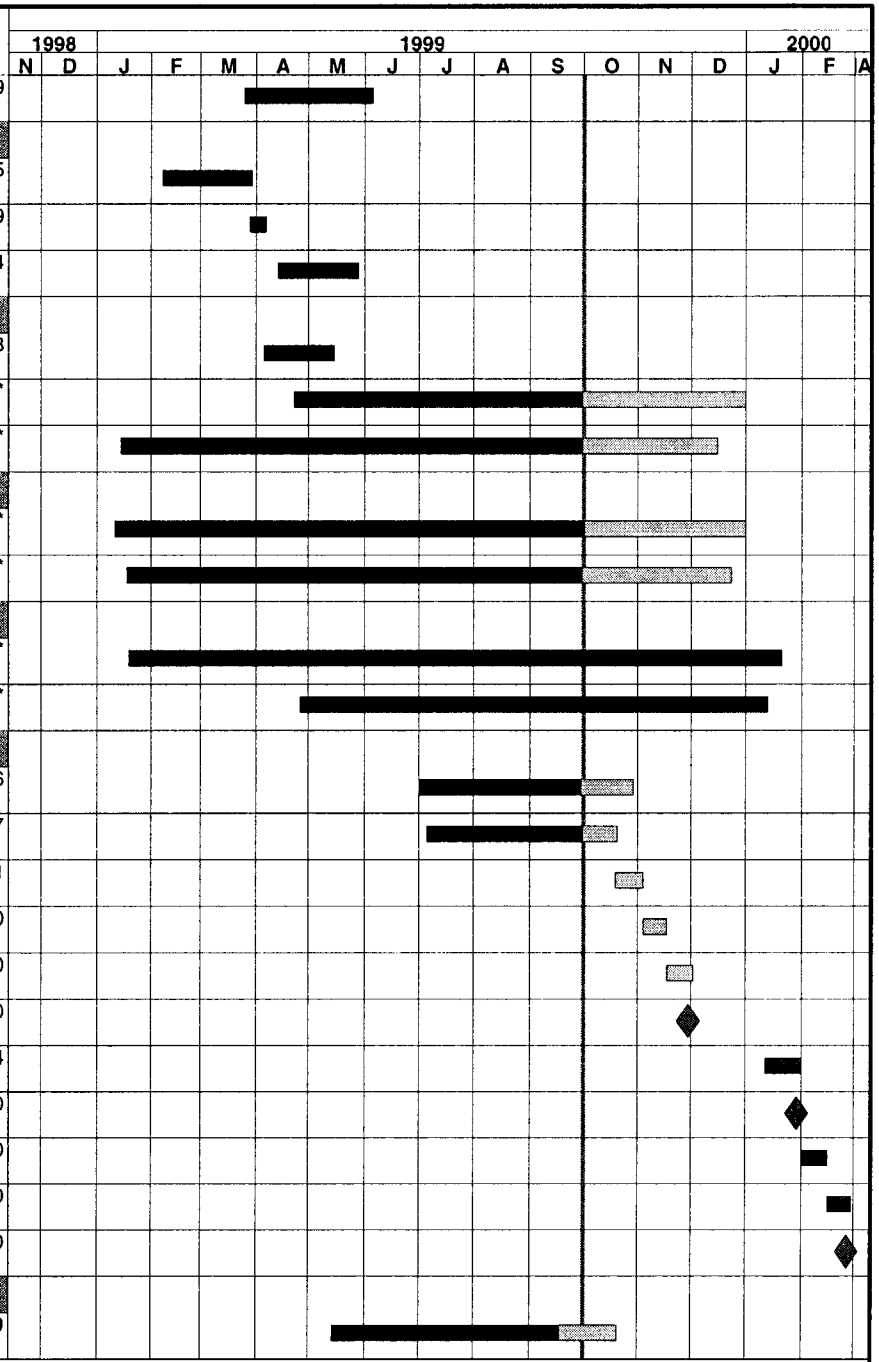
Sheet 1 of 3

SCHEDULE

Figure 5-3

JE®

| Activity ID | Activity Description | Early Start | Early Finish | Orig Dur |
|---|---|---|---|---|
| CRA2190D | RESTORE SITE | 26MAR99A | 04JUN99A | 59 |
| WBS 33.02.04 DRILLING/FIELD WORK | | | | |
| CRA2590K | IINSTALL WELL POINT SYSTEM (168) | 08FEB99A | 29MAR99A | 15 |
| CRA2599A | WORKAROUND/TREATMENT TO START-UP | 29MAR99A | 06APR99A | 9 |
| CRA2599B | WORKAROUND/TREATMENT COMPLETION GENERATOR | 14APR99A | 28MAY99A | 54 |
| WBS 33.02.05 SAMPLING | | | | |
| CRA3050A | TREATMENT PLANT RE-STARTUP SAMPLING | 06APR99A | 14MAY99A | 23 |
| CRA3055A | TREATMENT PLANT O&M SAMPLING | 23APR99A | 31DEC99 | 251* |
| CRA3095B | SURFACE WATER SAMPLING | 15JAN99A | 15DEC99 | 238* |
| WBS 33.02.09 ANALYTICAL | | | | |
| CRA3160A | ONSITE LAB ANALYSIS & VALIDATION | 12JAN99A | 30DEC99 | 251* |
| CRA3190A | OFFSITE LAB ANALYSIS & VALIDATION | 18JAN99A | 23DEC99 | 243* |
| WBS 33.02.90 DATA MANAGEMENT | | | | |
| CRA3205A | DATA MANAGEMENT (SURFACE WATER SAMPL;ING) | 19JAN99A | 20JAN00 | 260* |
| CRA3255A | TREATMENT PLANT O&M DATA MANAGEMENT | 26APR99A | 12JAN00 | 185* |
| WBS 33.21.06 POST CONSTRUCTION REPORTS | | | | |
| CRA3570B | PREPARE POST CONSTRUCTION REPORT | 01JUL99A | 29OCT99 | 86 |
| CRA3590G | PREPARE PM LETTER REPORT - STARTUP | 06JUL99A | 20OCT99 | 77 |
| CRA3590M | PREPARE PM LETTER REPORT - 3RD QTR | 20OCT99* | 03NOV99 | 11 |
| CRA3590O | AGENCY REVIEW PM LETTER REPORT - 3RD QTR | 04NOV99 | 17NOV99 | 10 |
| CRA3590P | PREPARE MEMO OF RESOLUTION - 3RD QTR | 18NOV99 | 01DEC99 | 10 |
| CRA3590Q | SUBMIT MEMO OF RESOLUTION - 3RD QTR | | 01DEC99 | 0 |
| CRA3590S | PREPARE PM LETTER REPORT - 4TH QTR | 12JAN00* | 31JAN00 | 14 |
| CRA3590T | SUBMIT PM LETTER REPORT - 4TH QTR | | 31JAN00 | 0 |
| CRA3590U | AGENCY REVIEW PM LETTER 4TH QTR | 01FEB00 | 14FEB00 | 10 |
| CRA3590V | PREPARE MOR - PM LETTER REPORT 4TH QTR | 15FEB00 | 28FEB00 | 10 |
| CRA3590W | SUBMIT MOR PM LETTER 4TH QTR | | 28FEB00 | 0 |
| WBS 33.12.51 TREATMENT SYSTEM - STARTUP | | | | |
| CRA5010B | O&M PLAN | 14MAY99A | 20OCT99 | 69 |




Project Start 01DEC98
Project Finish 30MAR00
Data Date 01OCT99
Run Date 19OCT99



WORKING SCHEDULE
Progress Bar
Critical Activity

1801

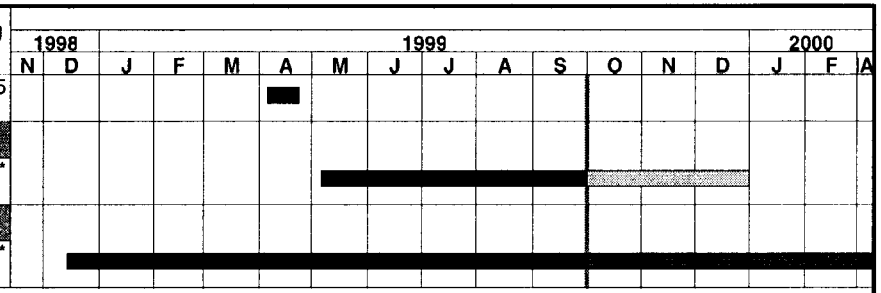
Sheet 2 of 3

SCHEDULE

Figure 5-3

JE®

| Activity ID | Activity Description | Early Start | Early Finish | Orig Dur |
|---|---|---|---|---|
| CRA5020A | TREATMENT SYSTEM STARTUP | 06APR99A | 23APR99A | 5 |
| WBS 38.12.52 TREATMENT SYSTEM O&M | | | | |
| CRA6010A | TREATMENT SYSTEM O&M | 06MAY99A | 30DEC99 | 169* |
| WBS 38.22.90 PROJECT MANAGEMENT/CORPORATE SPT | | | | |
| CRA8110A | PROJECT MANAGEMENT | 15DEC98A | 30MAR00 | 333* |




| | |
|---|---|
| Project Start | 01DEC98 |
| Project Finish | 30MAR00 |
| Data Date | 01OCT99 |
| Run Date | 19OCT99 |



WORKING SCHEDULE
Progress Bar
Critical Activity

1801

Sheet 3 of 3

SCHEDULE

Figure 5-3

JE®

# TABLES

## Table 2-1
## Irrigation Water Usage Summary for Affected Bogs and Farm

| Map Location ID* | Parcel Description | Owner / Manager | Crop | Water Source* | Acreage | Number of Sprinkler Heads | Required Flow Rate (gpm) | Design Flow Rate (gpm) |
|---|---|---|---|---|---|---|---|---|
| IG1 | Baptiste Bog | Handy | Cranberry | GW | 3.64 | 66 | 297 | 300 |
| IG2 | Baptiste Bog | Handy | Cranberry | GW | 6.60 | 119 | 536 | 500 |
| S1 | Augusta Bog | Augusta | Cranberry | SW | 7.50 | 135 | 608 | 600 |
| IG3 | Adams Bog | Adams | Cranberry | GW | 1.00 | 18 | 81 | 100 |
| | Lasalle Bog | Handy | Cranberry | GW | 1.50 | 27 | 122 | 150 |
| | Thompson Bog | Handy | Cranberry | GW | 1.91 | 35 | 158 | 160 |
| S2 | Thompson Bog | Handy | Cranberry | GW | 3.13 | 57 | 257 | 260 |
| S3 | Chaston Bog | Chaston | Cranberry | GW | 1.50 | 18 | 81 | 100 |
| S4 | Andrews | Andrews | Strawberries | GW | 10.24 | 184 | 828 | 800 |
| S5 | Reservoir Bog | Handy | Cranberry | GW | 7.84 | 142 | 639 | 650 |
| S6 | Middle Bog | Handy | Cranberry | GW | 13.68 | 247 | 1112 | 1200 |
| S7 | Lower Bog | Handy | Cranberry | GW | 10.60 | 191 | 860 | 900 |

GW = groundwater
SW = surface water
gpm = gallons per minute
Number of sprinkler heads = (18 sprinkler heads x acreage)
Required flow rate = (number of sprinkler heads x 4.5 gallons)
* See Figure 2-2.

## Table 4-1
## Risk Equivalent Concentrations in Surface Water for EDB (μg/L)

| Risk Level | Adult Wading | Child Wading | Adult Swimming | Child Swimming | Cranberry Worker | Adult Fisher | Integrated Receptor |
|---|---|---|---|---|---|---|---|
| $1 \times 10^{-7}$ | 0.0080 | 0.0090 | 0.0033 | 0.0052 | 0.0250 | 0.0008 | 0.00065 |
| $1 \times 10^{-6}$ | 0.0800 | 0.0900 | 0.0330 | 0.0520 | 0.2500 | 0.0080 | 0.0065 |
| $1 \times 10^{-5}$ | 0.8000 | 0.9000 | 0.3300 | 0.5200 | 2.5000 | 0.0800 | 0.0650 |
| $1 \times 10^{-4}$ | 8.0000 | 9.0000 | 3.3000 | 5.2000 | 25.0000 | 0.8000 | 0.6500 |
| $1 \times 10^{-3}$ | 80.0000 | 90.0000 | 33.0000 | 52.0000 | 250.0000 | 8.0000 | 6.5000 |

Notes:
Ingestion, dermal absorption, and inhalation exposure routes included.
Reasonable maximum exposure scenario is used.

# Table 5-1
# ARARs, Criteria, and Guidance for FS-28 Removal Actions

| REQUIREMENT | STATUS | REQUIREMENT SYNOPSIS | ACTION TO BE TAKEN TO ATTAIN REQUIREMENT |
|---|---|---|---|
| CHEMICAL-SPECIFIC REQUIREMENTS | | | |
| Federal | | | |
| Federal AWQC and Water Quality Standards (33 USC 1251 et seq.; 40 CFR 131.36 and 125.61) | Relevant and Appropriate | Federal AWQC are health-based criteria developed for carcinogenic and noncarcinogenic compounds and water quality parameters. AWQC are set at levels protective of human health for two routes of exposure: (1) drinking water and consuming fish, and (2) only consuming fish. Remedial actions must consider the uses of the water and the circumstances of the release or threatened release; this determines whether AWQC are relevant and appropriate. | These standards will be attained for discharge of treated water through compliance with NPDES standards for the ETR system |
| SDWA - MCLs (40 CFR 141.11 - 141.16) | Relevant and Appropriate | MCLs have been promulgated for organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies, but may also be considered relevant and appropriate for groundwater aquifers used for drinking water. | The ETR system are designed to treat extracted groundwater to these standards. |
| EPA Risk Reference Doses (RfDs) | To Be Considered | RfDs are considered since the levels are unlikely to cause significant adverse health effects associated with thresold mechanism of action in human exposure for a lifetime. | EPA RfDs were used to compute the cancer risk-based cleanup levels for noncarginogens. |
| EPA Carcinogen Assessment Group, Cancer Slope Factors (CSFs) | To Be Considered | CSF's represent the most up-to-date information on cancer risk from EPA's Carcinogen Assessment Group. | EPA CSFs were used to compute the cancer risk-based cleanup levels for EDB. |
| State | | | |
| Massachusetts Drinking Water Regulations (310 CMR 22.00) | Relevant and Appropriate | Massachusetts Drinking Water Standards are generally equivalent to federal MCLs. When state levels are more stringent than federal levels, the state levels must be attained. The state MCL for EDB is 0.02, which is more stringent than the federal MCL of 0.05. | The ETR system will be designed to treat extracted groundwater to these standards. |
| Massachusetts Groundwater Quality Standards (314 CMR 6.00) | Applicable | These standards limit the concentration of certain materials allowed in classified Massachusetts waters. The groundwater beneath MMR has been classified as Class I water or fresh groundwater found in the saturated zone of unconsolidated deposits and is designated as a source of potable water. | These standards will be attained because the clean-up levels or potential discharge limits were set using these as guidelines. |
| Massachusetts Surface Water Quality Standards (314 CMR 4.00) | Relevant and Appropriate | These regulations limit or prohibit discharges of pollutants to surface waters to assure that surface water quality standards of the receiving waters are protected and maintained or attained. Discharges may be limited or prohibited to protect existing uses and not interfere with the attainment of designated uses in downstream and adjacent segments. | No surface water treatment will be undertaken on this project. Discharge of treatment water will comply with these requirements for a Class B river if directly discharge to the Coonamessett River. |

## Table 5-1
## ARARs, Criteria, and Guidance for FS-28 Removal Actions

| REQUIREMENT | STATUS | REQUIREMENT SYNOPSIS | ACTION TO BE TAKEN TO ATTAIN REQUIREMENT |
|---|---|---|---|
| LOCATION-SPECIFIC REQUIREMENTS | | | |
| WETLANDS | | | |
| Federal | | | |
| Protection of Wetlands - Executive Order 11990 (40 CFR 6, Appendix A) | Applicable | Appendix A of 40 CFR 6 sets forth policy for carrying out provisions of the Protection of Wetlands Executive Order. Under this order, federal agencies are required to minimize the degradation, loss, or destruction of wetlands, and to preserve the natural and beneficial values of wetlands. Appendix A requires that no remedial alternatives adversely affect a wetland if another practicable alternative is available. If no alternative is available, effects from implementing the chosen alternative must be mitigated. | Removal actions (i.e., extraction of water for irrigation) within a cranberry bog or other wetland will be done in a manner to minimize the impact. Altered areas will be repaired or restored. |
| Section 401 of the Clean Water Act (33 USC 1341) | Applicable | This act requires certification or waiver from the state water pollution control agency (MADEP, Division of Water Pollution Control) to discharge dredge or fill material in the waters of the United States. DEP specifically requires a 401 Water Quality certification if the area to be altered or disturbed is greater than 5,000 square feet | Areas to be altered within the wetlands will be kept to less than 5,000 square feet and constructed on the areas already under agricultural crops. |
| Section 404 (b) of the Clean Water Act Amended 1977 (33 USC 1344) and Section 404(b) | Applicable | This act regulates the discharge of dredge or fill materials into all U.S. waters including Wetlands. The Corps of Engineers regulates both permanent and temporary work with compliance with 404(b) and issues appropriate permits either as a individual or under the Programmatic General Permit. | Certain activities being undertaken by this project are exempt under 40 CFR Part 232.2 and a permit is not required. For those activities that are not exempt, areas to be disturbed or altered will be kept below 5,000 square feet. AFCEE will request interpretation on the exemptions from EPA and the USACE. |
| Floodplain Management, Executive Order 11988 (40 CFR Part 6, Appendix A) | Applicable | Sets forth EPA policy for federal agencies to minimize potential harm to or within floodplains and avoid long and short term adverse impacts with modifications to floodplains. | Proposed activities do not harm the floodplain. The bogs are managed facilities that are not subject to flooding from external storm events. |
| Rivers and Harbors Act of 1899 (33 USC 403; 33 CFR Parts 320-323) | Relevant and Appropriate | Section 10 of the Rivers and Harbors Act of 1899 requires authorization from the Secretary of the Army, acting through the Army Corps of Engineers, for the construction of any structure in or over any "navigable water of the U.S." It also requires such authorization for the excavation from or deposition of material in such waters, or any obstruction or alteration in such waters. | All actions within navigable waters will be coordinated with the Army Corps of Engineers. |

## Table 5-1
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| REQUIREMENT | STATUS | REQUIREMENT SYNOPSIS | ACTION TO BE TAKEN TO ATTAIN REQUIREMENT |
|---|---|---|---|
| Fish and Wildlife Coordination Act (16 USC 661 *et seq.*) | Relevant and Appropriate | This act requires that any federal agency proposing to modify a body of water must consult with the U.S. Fish and Wildlife Service, National Marine Fisheries Services, and other related state agencies to develop measures to prevent, mitigate or compensate for project-related losses to fish and wildlife. Such action should be viewed in the context of obtaining maximum overall project benefits such as cleaning up the site. The requirements to comply with this Act are contained in EPA's NPDES permit regulations (40 CFR 122.49). | Actions will be taken to develop measures to prevent, mitigate or compensate for project-related impacts to fish and wildlife. Relevant agencies will be contacted to help analyze the impact on fish and wildlife from installing treatment, and discharging treated water to the Coonamessett River or cranberry bog. |
| | | | |
| State | | | |
| Massachusetts Wetlands Regulations (310 CMR 10.00) | Applicable | These regulations protect inland and coastal wetlands, as well as a 100-foot buffer zone, from activities that may alter the resource area. Some wetlands receive additional protection as wildlife habitat. Status of wildlife habitat is determined by the presence of particular plant communities or hydrologic characteristics.<br><br>The regulations specifically prohibit the loss of over 5,000 square feet of bordering vegetated wetlands. The loss may be permitted with replication of the lost area within two growing seasons. | A notice of intent will be prepared and submitted to the local conservation commission. This filing will result in an Order of Conditions. No work will begin until the Order of Conditions has been filed. If FS-28 removal actions alter more than 5,000 square feet of protected area, the affected area will be restored within two growing seasons. Retributions will be made in upland areas by creating a new holding pond. |
| ACTION-SPECIFIC REQUIREMENTS | | | |
| Federal | | | |
| RCRA Identification and Listing of Hazardous Wastes; Toxicity Characteristics (40 CFR Part 261.24) | Relevant and Appropriate | These requirements identify the maximum concentrations of contaminants for which the waste would be a RCRA-characteristic hazardous waste for toxicity. The analytical test given in Appendix II is referred to as the TCLP. | Spent carbon sent offsite for disposal (not including regeneration) will be analyzed for TCLP. If TCLP results exceed the standards in 261.24, the material will be disposed of offsite in a RCRA-permitted TSD facility. |
| National Pollutant Discharge Elimination System (NPDES) (40 CFR 122-125 and 131) | Applicable | Establishes discharge limitations, monitoring requirements and best management practices for any direct discharge from a point source into surface water. | Discharges of treated water (Alternatives C1, C2, and E) from surface water treatment or the ETR system into the Coonamessett River or cranberry bogs will meet these standards. |
| State | | | |
| Massachusetts Department of Public Health Food Tolerance Action Levels (105 CMR 515.00) | To Be Considered | Establishes food tolerance action levels for EDB | The removal actions being taken at the cranberry bogs will minimize the possibility that concentrations of EDB exceeding the food tolerance action levels are present in the cranberry crop. Cranberries will be sampled and analyzed as an additional measure of the action's performance. |

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| Requirement | Status | Requirement Synopsis | Action To Be Taken To Attain Requirement |
|---|---|---|---|
| Massachusetts Hazardous Waste Management Regulations Requirements for Generators of Hazardous Waste (310 CMR 30.300) | Relevant and Appropriate | This requirement sets standards for generators of hazardous waste that address (1) accumulating waste, (2) preparing hazardous waste for shipment, and (3) preparing the uniform hazardous waste manifest. | If RCRA-characteristic hazardous wastes are generated from the FS-28 treatment system or well installation and shipped offsite, the material must be shipped in proper containers that are accurately marked and labeled, and the transporter must display proper placards. All waste shipments must be accompanied by an appropriate manifest. |
| Massachusetts Air Pollution Control Regulations (310 CMR 7.00) | Applicable | These regulations set emission limits necessary to attain ambient air quality standards. | Removal actions (e.g., well drilling and the installation of piping) will be conducted to meet the standards for visible emissions (310 CMR 7.06); dust, odor, construction, and demolition (310 CMR 7.09); noise (310 CMR 7.10); and volatile organic compounds (310 CMR 7.18). If standards are exceeded, emissions will be managed through engineering controls. |

**Notes:**

ARAR = Applicable or Relevant and Appropriate Requirement
AWQC = Ambient Water Quality Criteria
CERCLA = Comprehensive Environmental Response Compensation and Liability Act
CFR = Code of Federal Regulations
CMR = Code of Massachusetts Regulations
CSFs = cancer slope factors
CWSW = Coonamessett Water Supply Wells
EDB = ethylene dibromide
EPA = United States Environmental Protection Agency
ETR = extraction, treatment, reinjection
MCLs = Maximum Contaminant Levels
MGL = Massachusetts General Law
MMR = Massachusetts Military Reservation
NPDES = National Pollutant Discharge Elimination System
RCRA = Resource Conservation and Recovery Act
RfDs = Reference Doses
SDWA = Safe Drinking Water Act
TCLP = Toxicity Characteristic Leaching Procedure
TSD = treatment, storage, disposal
USC = United States Code

# APPENDIX

# RESPONSE TO PUBLIC COMMENTS

**Comment:** December 11, 1998, Letter—Edward J. Boyer, 55 Ranch Road, E. Falmouth, MA 02536:

- I read about the problems with cranberry bogs in Falmouth being contaminated and your efforts to restore them. I think it's a good idea. The EDB will be removed and the Cape will experience more income. My concern is Coonamessett Pond. What is the status of it? Children as well as adults swim in it, people fish in it but is there any danger there? I don't hear the Pond mentioned at all. I thought the river ran right through it. Please straighten me out.

**Response:** AFCEE appreciates your positive feedback. The Coonamessett River starts or begins at the western edge of Coonamessett Pond and then flows into Great Pond south of Route 28. Because the pond is the headwaters of the river, the river does not flow through Coonamessett Pond, and the EDB that has been detected in the river has no effect on the pond. Extensive sampling and analysis has been completed for the Coonamessett Pond. This effort was conducted during the spring of 1998 as part of the Southwest Operable Unit Remedial Investigation. Volatile organic compounds, (including ethylene dibromide) were not detected during this sampling period. Additional information can be found in the May 1999 *Final SWOU Remedial Investigation.*

**Comment:** December 21, 1998, Letter—Brian E. McDermott, Hunziker & McDermott, Counsellors at Law, 182 Palmer Avenue, P.O. Box 547, Falmouth, MA 02541:

- ...AFCEE made it clear from the outset that E was its choice. This choice was made without any public input or disclosure by AFCEE as to the hard costs of E, the results of various test wells and other pertinent information. Instead the public was fed a lot of "probably", "hopefully", "we think", "maybe", and "maybe we will get lucky". In essence the AFCEE choice was made without any basis in fact being made to the public.

  The public was informed at the outset in September that this decision had to be made within two weeks or the matter would go up the ladder and be out of local control. Further, it was stated that the Air Force will be out of the cranberry business by the end of 1999, irrespective of conditions at that time.

  At no time was even lip service given to the impact of EDB on the environment generally, let alone the impact of EDB combined with the impact of the continued operations of the cranberry bogs on the waterways, fish and plant species in particular.

In short, the plan adopted is ill conceived, ineffectual, unworkable, unsightly and the result of unilateral "Cram Down Mentality" on the part of the AFCEE.

**Response:** AFCEE held various meetings with stakeholders since January 1997 to discuss and narrow the alternatives for remediation of ethylene dibromide contamination in the Coonamessett River. AFCEE and the prime subcontractor, Jacobs Engineering Group Inc., have conducted numerous studies (flooding of the bogs, shallow well pilot tests) to reduce the uncertainty of the effort. These efforts have been successful in showing that the EDB levels in the river can be lowered without ecological impacts. AFCEE firmly believes that the preferred alternative is a workable solution that considers all aspects of the river and the surrounding neighborhood. The additional cleanup effort is being conducted to further reduce risk to any recreational users as well as the cranberry workers exposed to the contaminated surface water.

**Comment:** December 10, 1998, Public Hearing, Douglas Karson as Hearing Officer, Unitarian Universalist Church, 840 Sandwich Road, Falmouth, MA—Gail MaCrae:

- You know, I've been reading recently in the paper about all the things, the Air Force and the budget and the problems with costs and allowing some plumes just to go out naturally. I find it very interesting to see how much money, which I'm happy because I live in this neighborhood, but I do find it very interesting the amount of money that has been put into the FS-28, and how much money is going into the cranberry bogs. I find it all just very interesting, and that's my comment. Whether we have plumes that are heading up into Cataumet and we want to let those just go, I wonder, I question whether this is really about a cleanup or whether it's about protecting a commodity that's very special to the state of Massachusetts, and that's called a cranberry.

**Response:** AFCEE is undertaking the response action to further reduce the levels of EDB contamination found upwelling into the Coonamessett River. Unlike other groundwater plumes, the FS-28 EDB contamination has reached its point of exit, which poses an unacceptable risk to the cranberry workers and recreational users of the surface water. By limiting the points of exposure to the contamination and reducing the contamination, the risk to these individuals will be reduced.

AFCEE is committed to continue community involvement after 1999 when the SWOU remedies will be selected, implemented, and monitored.

**Comment:** December 10, 1998, Public Hearing, Douglas Karson as Hearing Officer, Unitarian Universalist Church, 840 Sandwich Road, Falmouth, MA—Robin Singer:

- I would just like to state my preference for the alternative that allows the bogs to go wild until the pollution is past. I think that the highly toxic nature of ethylene dibromide is such that it's playing with fire to think that we can control the situation adequately. So I think the alternative that allows the bogs to grow wild and not produce cranberries during the time that the pollution is present would be preferable.

**Response:** The long-term usage of the bogs is a decision that must be addressed by the Town of Falmouth and the other private bog operators. The engineered solution is a balanced approach that has demonstrated performance (in the November 1998 pilot study). Furthermore, the preferred alternative will reduce the levels of EDB and accelerate the cleanup of the Coonamessett River, and if no action is taken, the risks to recreational users of the river would not be addressed.

**Comment:** December 10, 1998, Public Hearing, Douglas Karson as Hearing Officer, Unitarian Universalist Church, 840 Sandwich Road, Falmouth, MA—Donald Mack:

- I abut the Baptiste bogs. And I'm concerned about the back in the Augusta property, that the whole area that's going to be – all the trees will be taken down, and I think it's a darn shame to have that whole area cut down, and to have – to look out my back window and see nothing but a sand pile which, prior to Tom, that's what Augusta wants to do with that sand pile. I've been down there for 18 years and I've never seen a sand pile that big in all the time I've been there. You know, I think it's unnecessary to have such a big sand pile there, and to destroy all those trees on that edge there. When I look out my back window, all I'm going to see is a big gravel pit of sand, and I think it's very unfortunate. And also, I've several times seen children playing around that sand pile, the top of it, and I'm just thankful no one had been hurt so far.

**Response:** During construction we will be working with the bog operators to develop alternatives that will minimize the impact to the trees in this area and will also address the esthetics of the size of the sand pile.